July 2003

Economic Analysis of Management Alternatives for Personal Watercraft in Bighorn Canyon National Recreation Area

Revised Final Report

Prepared for

Dr. Bruce Peacock
National Park Service
Environmental Quality Division

Prepared by

MACTEC Engineering and Consulting, Inc.
(f/k/a LAW Engineering and Environmental Services, Inc.)
3200 Town Point Drive, NW, Suite 100
Kennesaw, GA 30144

BBL Sciences, Inc.
301 East Ocean Blvd.
Long Beach, CA 90802

and

RTI International
Health, Social, and Economics Research
3040 Cornwallis Road
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1 Introduction

Historically, NPS classified PWC with other water vessels, which allowed their use when the use of other vessels was permitted. More recently, NPS has reevaluated its methods of PWC regulation. This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Bighorn Canyon National Recreation Area (BICA).

Historically, the National Park Service (NPS) classified personal watercraft (PWC) with all other water vessels, which allowed people to use PWC when the use of other vessels was permitted by a Superintendent's Compendium.[1] In recognition of its duties under the Organic Act and NPS Management Policies, as well as increased awareness and public controversy, NPS reevaluated its methods of PWC regulation. Because of new information regarding potential resource impacts, conflicts with other users, and safety concerns associated with PWC use, NPS proposed a PWC-specific regulation in 1998. The regulation stipulated that PWC would be prohibited in units of the national park system unless NPS determines that PWC use is appropriate for a specific unit based on that unit's enabling legislation, resources and values; other visitor uses; and overall management objectives (63 FR 49,312–17, September 15, 1998). This report describes the results of an economic analysis of the proposed alternatives for regulating PWC use in Bighorn Canyon National Recreation Area (BICA), located in south-central Montana into north-central Wyoming.

During a 60-day comment period, NPS received nearly 20,000 comments on this proposed regulation. As a result of public comments and further review, NPS promulgated an amended regulation in March 2000. This amended regulation allows NPS to

[1] A compendium is an NPS management tool used specifically by a park superintendent to take actions to address park-specific resource protection concerns.

permit PWC use in 11 units by promulgating a special regulation and in an additional 10 units by amending the Superintendent's Compendiums (36 CFR 3.24[b], 2000). The March 2000 regulation provided park units a 2-year grace period in which PWC use could continue, after which time PWC would be banned from any park that took no action to promulgate either PWC-specific regulations or to regulate PWC use in the Superintendent's Compendium.

On August 31, 2000, Bluewater Network et al., filed a complaint with the United States District Court for the District of Columbia against NPS alleging, among other things, that the NPS rule-making decisions to allow PWC use in some park units after 2002 by making entries in Superintendent's Compendiums would not provide the opportunity for public input. In addition, the environmental group claimed that because PWC cause water and air pollution, generate noise, and pose public safety threats, NPS acted arbitrarily and capriciously when making its September 1998 and March 2000 decisions.

A settlement agreement between NPS and Bluewater Network was signed by the District Court on April 12, 2001. The agreement requires all park units wishing to continue PWC use to promulgate special regulations only after each unit conducts an environmental analysis in accordance with the 1969 National Environmental Policy Act (NEPA). At a minimum, the NEPA analysis must evaluate the impacts of PWC on water quality, air quality, soundscapes, wildlife, wildlife habitat, shoreline vegetation, visitor conflicts, and visitor safety. In addition, NPS is required by federal statutes, including Executive Order 12866, to conduct a benefit-cost analysis of the proposed regulation and analyze the impact of the regulation on small businesses under the Regulatory Flexibility Act (RFA) of 1980. Based on this settlement, PWC use in BICA was to be prohibited after September 15, 2002, if a final rule permitting their use was not promulgated. However, a stipulated modification to this settlement agreement was approved by the court on September 9, 2002, that permitted PWC use in BICA until November 6, 2002. After that date, PWC use in BICA is prohibited until the final rule is published.[2] This report describes the results of an economic

[2]Under the no-action alternative, PWC use would continue to be banned.

analysis of the proposed alternatives for regulating PWC use in BICA, as required by the terms of the April 2001 settlement and by applicable federal statutes.

1.1 ORGANIZATION OF REPORT

This report presents NPS's economic analysis of the alternative BICA PWC regulations under consideration. The report is organized as follows. Section 1 describes the reason for the regulation and the current and proposed regulations at BICA. Baseline visitation, environmental conditions, and economic activity in BICA are described in Section 2. The local economic impacts on the region surrounding BICA are summarized in Section 3. Section 4 describes the methodology for assessing the impacts of the alternatives on social welfare and presents a benefit-cost analysis of the regulatory alternatives. Section 5 provides an analysis of the regulatory alternatives' impacts on small businesses. Uncertainties are addressed in Section 2 for visitation, Section 3 for regional economic impacts, and Section 5 for the alternatives' impacts on businesses. In addition, Appendix A describes the principles of economic impact analysis, and Appendix B includes a detailed theoretical discussion of the types of benefits and costs associated with PWC restrictions in national parks and the methods used in their estimation.

1.2 PROBLEM ADDRESSED BY REGULATION

In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation.

The U.S. Office of Management and Budget (OMB) directs regulatory agencies to demonstrate the need for their rules (OMB, 1992). In general, regulations should be imposed only where a market failure exists that cannot be resolved efficiently by measures other than federal regulation. If each producer and consumer has complete information on his or her actions and makes decisions based on the full costs of those actions, resources will be allocated in a socially efficient manner. However, when the market's allocation of resources diverges from socially optimal values, a market failure exists. A defining feature of a market failure is the inequality between the social consequences of an action and a purely private perception of benefits and costs. The major causes of market failure identified in the OMB guidance on Executive Order 12866 are externalities, natural monopolies, market power, and

inadequate or asymmetric information. For environmental problems resulting from market failures, this divergence between private and social perspectives is normally referred to as an externality. Such divergences occur when the actions of one economic entity impose costs on parties that are external to, or not accounted for in, a market transaction or activity.

The justification for restricting PWC use in national parks is based on externalities associated with their use. For instance, the operation of PWC imposes costs on society associated with noise emissions, air and water pollution emissions, and health and safety risks. Because PWC users have little incentive to consider these external costs, they are likely to make decisions about PWC use without taking these impacts on other people into account.

The extent to which social welfare improves because of PWC regulation depends on the relative costs and benefits associated with such restrictions. Although non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses.

If these externalities are internalized to the PWC users generating them, the problem can be mitigated. For example, if PWC users were required to pay for the marginal external costs they impose on others, they would begin to take those costs into account when making decisions and the market failure would be corrected. However, accurately assigning costs associated with each individual PWC user's actions and enforcing payment is essentially infeasible at this time. Other regulatory options to address the externalities associated with PWC use are far easier to implement and enforce. Some of these options include restricting areas where they are permitted, the time of day when they can be used, and PWC engine type.

The extent to which social welfare improves because of PWC regulation depends on the relative benefits and costs associated with such restrictions. Although non-PWC users gain from PWC restrictions, the PWC users and local businesses that serve them experience welfare losses. Thus, the likelihood that a particular regulatory option will improve social welfare in an individual national park unit depends on numerous park-specific factors that influence the level of benefits and costs. Although a given set of restrictions on PWC use in one park may improve social welfare, the same set of restrictions in another park could easily have negative impacts on social welfare. For example, banning PWC in a park where there is little other motorized boating activity may result in large proportionate reductions in noise and emissions, whereas banning PWC in a park with a high level of other motorized boating

activity may not have a noticeable effect on noise or emissions levels. In the latter case, the costs to PWC users could be larger than the gains to other park visitors. Thus, it is important to consider the conditions specific to each individual park in selecting the preferred regulatory alternative for that park.

1.3 CURRENT PWC ACTIVITIES AT BICA

PWC use is currently prohibited in BICA. In accordance with the September 9, 2002, stipulated modification to the April 2001 settlement agreement, PWC use in BICA was prohibited after November 6, 2002, until a final rule authorizing its use is promulgated. For the purposes of the analyses in this report, the PWC ban is considered baseline conditions in BICA.

1.4 PROPOSED REGULATIONS

The following three alternatives are being considered for the management of PWC in BICA, as presented in the Environmental Assessment (EA) of PWC use at BICA (NPS, 2003).

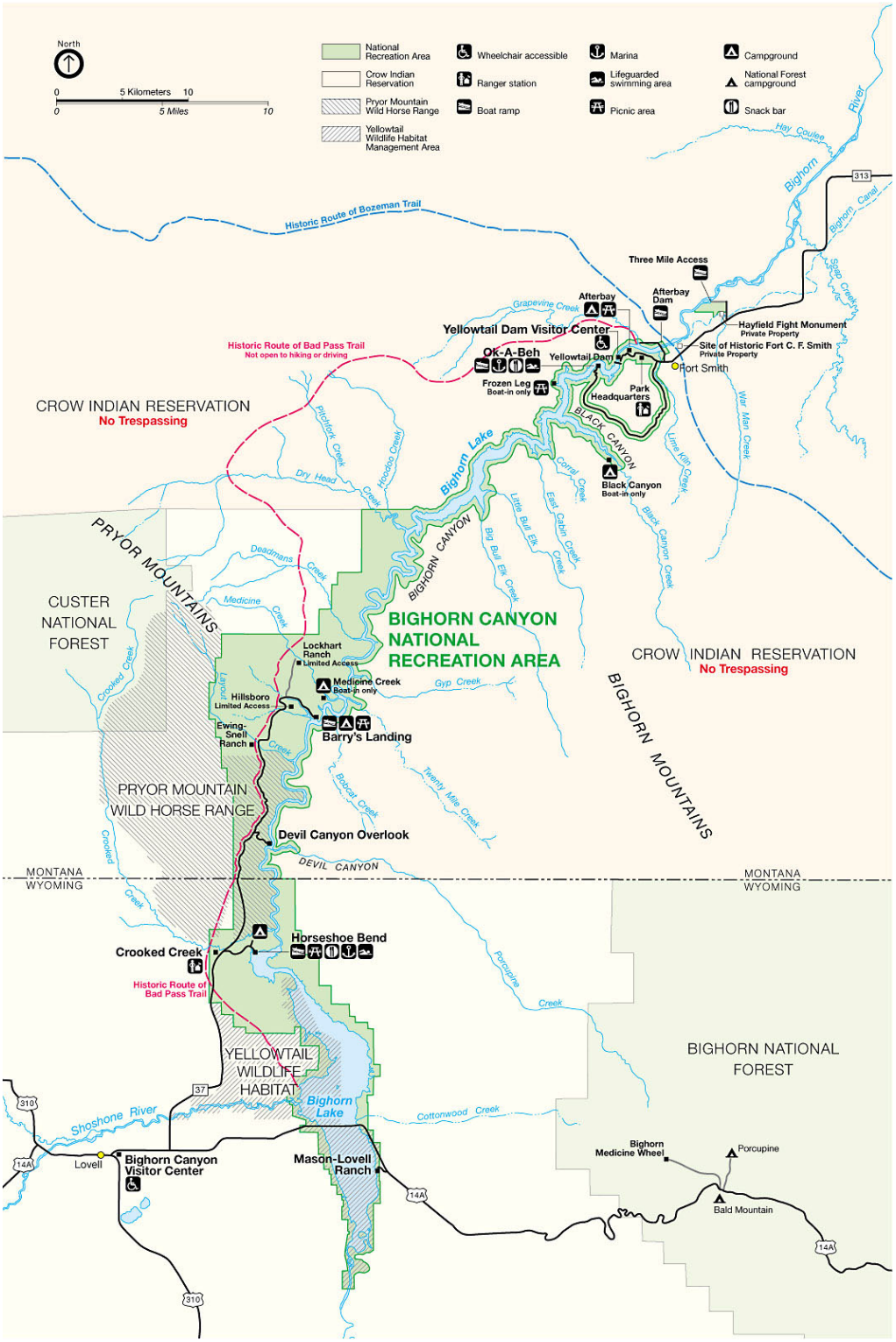
Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation

Under Alternative A, a special regulation would be promulgated to reinstate PWC in BICA as permitted in the Superintendent's Compendium and state regulations prior to the November 7, 2002, ban.

In the Superintendent's Compendium, PWC are regulated as vessels; thus, PWC use would be authorized in all areas of BICA where boats are allowed. The following areas would remain closed to PWC operations (see Figure 1-1):

- gated area south of Yellowtail Dam's west side to spillway entrance works, and Bighorn River from Yellowtail Dam to cable 3,500 feet north;
- at Afterbay Dam—from fenced areas on the west side of dam;
- Afterbay Lake—area between dam intake works and buoy/cable line 100 feet west;
- government docks as posted;
- at Ok-A-Beh gas dock (customers excepted); and
- from Yellowtail Dam upstream to the log boom.

Figure 1-1. Map of BICA



Docking would be limited at courtesy docks at Ok-A-Beh, Barry's Landing, Horseshoe Bend, and at the Box Canyon Comfort Station Dock (exclusive of adjacent slips) to 15 minutes (official and concession vessels excepted), and Crooked Creek Bay would be closed to towing of people and PWC use.

NPS wake restrictions are in effect in several areas of the lake, and the affected areas are marked by buoys. PWC use in BICA would be subject to all Wyoming and Montana boating laws and regulations, which also include wake restrictions. Montana state regulations stipulate that flat-wake speed must be maintained when within 200-feet of a dock, swimmer, swimming raft, nonmotorized boat, or anchored vessel. Wyoming state regulations stipulate that no person operating a PWC shall cross or jump the wake of another watercraft when within 100 feet of the watercraft creating the wake.

With respect to vessel operation/safety, Wyoming and Montana state laws would continue to apply to PWC operators. Montana boating laws require riders of PWC equipped with a lanyard to have it attached to the operator's wrist or personal floatation device. Stand-up PWC and PWC towing a water skier must travel at a minimum speed necessary to operate when leaving from or returning to a dock or shore. A person must be 18 years or older to rent a PWC powered by a motor rated at more than 10 horsepower. Children 12 years old or younger may not operate a PWC powered by a motor rated at more than 10 horsepower unless accompanied by someone 18 years of age or older. Similarly, children 13 and 14 years of age may not operate PWC without possessing a valid Montana motorboat operator's safety certificate or evidence of completing an approved water safety course, or unless accompanied by someone 18 years of age or older.

Wyoming law requires PWC riders to be at least 16 years old or accompanied by an adult. Wyoming laws also require PWC to be equipped with a "kill switch" and for the lanyard to be attached to the operator. Boating laws in both states require PWC users to wear personal floatation devices.

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation, but with Additional Management Prescriptions

Alternative B would reinstate PWC use under a special regulation that would allow PWC operation similar to Alternative A, as above, but the additional management strategies would be adopted. In addition to those identified in Alternative A, the following areas would be closed to PWC:

- The reservoir and shoreline south of the area known as the South Narrows; the legal description is R94W, T57N at the SE corner of Section 6, the SW corner of Section 5, the NE corner of Section 7, and the NW corner of Section 8.

BICA would install buoys to delineate the boundary. PWC users would be required to stay north of this boundary.

Proposed Regulations for PWC Use in BICA

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation, but with Additional Management Prescriptions

Alternative C: No-Action (Continue PWC Ban)

All applicable Montana and Wyoming laws would continue to apply to PWC users, as indicted in Alternative A. Finally, BICA would establish a PWC user education program implemented through vessel inspections, law enforcement contacts, and signing.

Alternative C: No-Action (Continue PWC Ban)

Under the no-action alternative, no unit-specific rule would be promulgated to reinstate PWC use in BICA. Therefore, PWC use would be prohibited in BICA permanently, in accordance with Bluewater Network v. Stanton, No. CV02093 (D.D.C. 2000), the settlement agreement approved by the court on April 12, 2001, and subsequent September 9, 2002, modification.[3]

[3]As noted above, PWC are currently banned from BICA until the publication of the final rule for management of PWC use in the park. Under the no-action alternative, this temporary ban would become permanent.

2 Description of PWC Use in Bighorn Canyon National Recreation Area

PWC use in BICA could potentially have negative impacts on water and air quality, soundscapes, wildlife and wildlife habitats, and cultural and ethnographic resources. However, because of the relatively small number of PWC used in BICA prior to the baseline, the reinstatement of PWC use is estimated to impose only minimal incremental impacts on these resources.

BICA was established by Congress in 1966, following construction of the Yellowtail Dam on Bighorn River and the subsequent creation of Bighorn Lake. The National Recreation Area (NRA), which encompasses more than 70,000 acres, extends 60 miles from south-central Montana into north-central Wyoming. In addition to Bighorn Lake, which extends the length of BICA, the NRA includes stretches of 18 rivers, desert shrub land, juniper woodland, and pine and fir woodland. In Montana, BICA is largely bordered to the east and west by the Crow Indian Reservation. In Wyoming, BICA lies approximately 35 miles west of the Bighorn National Forest and 100 miles east of Yellowstone National Park (Figure 1-1).

2.1 PWC USE, AREA ACCESS, MAINTENANCE, AND ENFORCEMENT AT BICA

Although PWC are currently banned in BICA (see Section 1.3), this section reviews PWC access, maintenance, and enforcement prior to the ban. PWC were first used in BICA around 1997. The typical PWC use season lasted approximately 12 weeks, from early June until late August, and mirrored the period of peak use of other motorized watercraft.

PWC access to Bighorn Lake in Montana was provided at two paved landings: Ok-A-Beh in the northern part of BICA, near

Afterbay Dam, and Barry's Landing near the middle portion of BICA. According to NPS, minimal PWC launching also occurred from the shore of Afterbay Lake, located slightly north of Ok-A-Beh. PWC access to Bighorn Lake in Wyoming was provided at Horseshoe Bend landing. PWC launching from other shoreline areas was largely prevented by steep canyon walls, although there were some areas of shoreline where PWC could launch. All three landing areas in BICA offer swimming, picnicking, and restroom facilities. Barry's Landing and Horseshoe Bend also offer camping. Ok-A-Beh and Horseshoe Bend provide marina facilities.

BICA did not provide any facilities specifically for PWC users. Boat launches were shared with other watercraft, and other park facilities (e.g., restrooms, picnic areas) are used by all park visitors. Park maintenance associated with PWC use was therefore incidental to other park operational costs.

BICA did not have law enforcement or park officials dedicated exclusively to regulating PWC use. Cost of enforcement activities associated with PWC therefore is incidental to other park operational costs. At BICA, there are three full-time protection rangers and three seasonal protection rangers whose job is to enforce all regulations throughout the recreation area. During periods of heavy watercraft use, such as weekends and holidays, one or two rangers may be on Bighorn Lake patrolling for 1 to 3 hours per day enforcing state boating regulations. State enforcement presence on Bighorn Lake in both Montana and Wyoming is limited to sporadic visits.

The number of reported violations or accidents involving PWC was low. The most common citation was for underage riding. Other common citations were for wake jumping, approaching boats too closely, violation of no-wake restrictions at marinas, and failure to wear floatation devices. There was one recorded accident involving a PWC in 2000 and one accident in 2001. Complaints regarding misuse of PWC were received infrequently, and the most common complaints were creation of wakes in the flat-wake zones near boat launch areas. BICA has received no written complaints regarding PWC use (NPS, 2003).

2.2 VISITATION DATA

Sections 3 and 4 present analyses of the economic impacts and the social benefits and costs of PWC use under alternative regulations in BICA from 2003 through 2012. To support the development of these estimates, Section 2.2 presents projections of baseline PWC and non-PWC visitation for this period and discusses the methodology used to calculate the projections. The projected baseline represents visitation to BICA after imposing the ban on PWC use, as discussed in Section 1. In addition, projected visitation expected to have occurred in the absence of the ban is presented.

2.2.1 Historical BICA Visitation Data

As shown in Table 2-1, recreational visitation to BICA has fluctuated over the last 2 decades. Visitation during the late 1980s was much higher than it has been over the last several years. However, visitation has grown steadily since 1997, when only 190,500 people visited BICA for recreational purposes.

Table 2-1. Annual Recreational Visitation to BICA, 1979–2001

Year	Total Visitation	Year	Total Visitation
1979	297,152	1991	481,098
1980	322,728	1992	459,660
1981	341,157	1993	397,336
1982	391,017	1994	410,594
1983	373,150	1995	378,180
1984	379,625	1996	301,533
1985	456,020	1997	190,509
1986	455,228	1998	279,637
1987	452,103	1999	234,013
1988	441,172	2000	238,049
1989	455,401	2001	241,388
1990	463,311		

Source: National Park Service (NPS). 2002a. "Park Visitation Report." <http://www2.nature.nps.gov/stats/>. As obtained April 2002.

NPS officials report that the estimated total number of visitors to BICA in 2001 was 248,288, with approximately 241,388 (97 percent) of these being recreational users. The highest visitation rates occurred in June, July, and August, when approximately 118,691 people (47 percent of 2001 total) visited BICA. Table 2-2 presents monthly estimates of recreational use in 2001.[1]

Table 2-2. Monthly Recreational Visitation to BICA, 2001

Month	Recreational Visits
January	7,337
February	5,077
March	10,341
April	15,942
May	28,198
June	35,745
July	46,395
August	34,076
September	24,606
October	14,936
November	11,585
December	7,150
Total	241,388

Source: National Park Service (NPS). 2002a. "Park Visitation Report." <http://www2.nature.nps.gov/stats/>. As obtained April 2002.

2.2.2 Historical BICA Watercraft Visitation Data

NPS officials estimate that prior to the November 2002 ban, PWC accounted for less than 5 percent of total watercraft present in BICA during peak season (June through August). In 2001, an estimated 9,606 watercraft were used in BICA, including 449 PWC (accounting for 4.7 percent of watercraft). Approximately 7,500 of those watercraft (including approximately 360 PWC) were used during the peak summer season. These estimates are based on

[1] At the time this report was written, visitation data were not available for 2002. Because PWC use was not banned in 2002, the projections presented in this report begin in 2003, the first year of the current ban on PWC use.

traffic counters placed at park entrances and on-water observations by park personnel (NPS, 2003).

Estimates of average group size for PWC users were not available for BICA. However, other parks where estimates of group size for PWC users are available include Lake Meredith National Recreation Area, Glen Canyon National Recreation Area, and Lake Mead National Recreation Area, and average group size in BICA can reasonably be assumed to be similar to these parks. The estimated group size for PWC users at these parks ranges from 3.0 to 4.5 people per PWC (MACTEC et al., 2002a, b; 2003), with an average of approximately 3.5 people per PWC. Applying this average group size to BICA PWC counts implies that there were approximately 1,572 PWC users in BICA in 2001.

Absent additional information on PWC use in BICA, NPS assumes that BICA park staff have the best available data on total PWC visitation to the park.

Prior to the ban, PWC used in BICA typically were two- to three-person machines with conventional two-stroke engines. Most PWC users visited BICA for 1 or 2 days for the primary purpose of using PWC.

Absent additional information on PWC use in BICA, NPS assumes that BICA park staff have the best available data on PWC use in the park. Thus, BICA park staff estimates of PWC use are the primary values used in the economic analyses.

2.2.3 Projected Visitation

Methodology for Projecting Visitation

To project PWC and non-PWC visitation for the years 2003 through 2012, NPS used the following methodology:

Baseline

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using estimates of PWC use in 2001 relative to total recreational visits.

3. Project baseline non-PWC visitation for the period 2003–2012 by allowing non-PWC visitation to change from the 1997–2001 average at the population growth rate for the areas from which most visitors to the park originate. The average annual growth of the regional population[2] from 1990 to 2000 was 1.19 percent (U.S. Census Bureau, 2002).
4. Assume there would be no PWC use in 2003–2012 under baseline conditions because of the current ban on PWC use in BICA.
5. Project visitation by former PWC users by assuming a certain fraction will continue to visit BICA to engage in activities other than PWC use following the ban. These percentages will typically be based on professional judgment, because of the absence of a formal study of PWC use in BICA.

Without Ban

1. Calculate average recreational visitation over the five most recent years with data available (1997–2001).
2. Divide the recreational visitation estimated in Step 1 between PWC and non-PWC visitation using an estimate of 1,572 PWC users in 2001. This results in an estimate of PWC users accounting for 0.651 percent of total recreational visitation.
3. Estimate PWC visitation for 2003–2012 by using the estimates of annual growth in PWC use presented in the EA of PWC use at BICA (NPS, 2003). NPS estimates that without the ban PWC use would increase at an annual rate of 1 percent per year between 2002 and 2012 (NPS, 2003). The numbers of PWC registered in Montana and Wyoming have been rising more than 1 percent per year in recent years.[3] However, because registrations have been increasing at a decreasing rate, fluctuations in water levels cause periodic lake closures, and overall use of the recreation area has been declining since the mid-1990s, NPS determined that a 1 percent average annual increase in PWC use is reasonable and that PWC registration data are not a reliable basis for predicting future PWC use in BICA.

Projecting Visitation for 2003 through 2012

Following the methodology outlined above, NPS calculated BICA average annual recreational visitation for 1997 through 2001 to be

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[2]The two Montana counties around BICA identified for this analysis are Carbon and Bighorn. The Wyoming county identified is Bighorn.

[3]PWC registrations in the State of Montana increased 14.4 percent per year from 1994 to 2002, 5.8 percent per year from 1998 to 2002 and 4.5 percent per year from 2000 to 2002 (Montana Fish Wildlife and Parks, 2003). PWC registrations in Wyoming increased 10 percent from 1997 to 1998, 8.6 percent from 1998 to 1999, and 4.2 percent from 1999 to 2000 (NPS, 2003).

236,719. According to NPS estimates, approximately 0.651 percent of 2001 visitors used PWC in BICA. Assuming that the percentage of PWC visitors remained relatively constant over time, this implies an annual average of 1,541 PWC users and 235,178 non-PWC users from 1997 to 2001.

There will be no PWC use in BICA in the future under baseline conditions.

As described above, NPS projects that non-PWC visitation will grow at the rate of population growth for the areas where most visitors to BICA originate. According to the U.S. Census, population in the two Montana counties and one Wyoming county surrounding the park experienced an average population growth rate of 1.19 percent annually from 1990 to 2000 (U.S. Census Bureau, 2002). This is above the national average of 0.9 percent.

For 2003 to 2012, there is assumed to be no baseline PWC use in the park because PWC are banned in the baseline as of November 2002. However, many of the former PWC users who can no longer use a PWC in BICA may continue to visit the park to pursue other types of recreation. It was assumed that 80 percent of PWC users would continue to visit the BICA park region under the ban. This percentage is based on professional judgment and reflects the uniqueness of BICA compared with other recreation areas in the region. Based on the estimated regional population growth rate and the assumed percentage of former PWC users who stop using PWC in the park that will continue to visit the park for other activities, NPS presents the projected baseline visitation for BICA from 2003 to 2012 in Table 2-3.

To estimate the incremental impacts of the alternative management strategies (see Sections 3 and 4), the change in visitation relative to these baseline conditions must be projected. Table 2-4 presents the projected visitation that would have taken place in the absence of the November 2002 ban on PWC use in BICA.

2.2.4 Sources of Uncertainty in Visitation Projections

NPS estimates of PWC and non-PWC visitation in the years 2003 through 2012 are based on a number of assumptions. In addition, a variety of unpredictable circumstances could affect visitation in a particular year. In general, visitation to BICA in a specific year will depend on many factors, including

Table 2-3. Projected Baseline Visitation to BICA, 2003–2012[a]

Year	PWC Users	Non-PWC Users			Total Visitation
		Non-PWC Users in the Absence of the Ban	Visitors that Would Have Used PWC in the Absence of the Ban[b]	Total Non-PWC Users	
2003	0	240,787	1,258	242,045	242,045
2004	0	243,642	1,258	244,900	244,900
2005	0	246,530	1,258	247,788	247,788
2006	0	249,453	1,258	250,711	250,711
2007	0	252,410	1,258	253,668	253,668
2008	0	255,403	1,258	256,660	256,660
2009	0	258,431	1,258	259,688	259,688
2010	0	261,494	1,258	262,752	262,752
2011	0	264,594	1,258	265,852	265,852
2012	0	267,731	1,258	268,989	268,989

[a]These projections are based on the estimated regional population growth rate and the assumed percentage of former PWC users who stop using PWC in the park because of the ban but who will continue to visit the park for other activities. There is no PWC use in the park after November 6, 2002, under baseline conditions because PWC were banned as of that date.

[b]This category represents visitors who would have used PWC in BICA in the absence of the ban but would continue to visit the park to engage in alternative activities following the ban. These values were calculated based on an assumption that 80 percent of people who would have used PWC in the park in the absence of the ban would continue to visit the park to engage in alternative activities. It was also assumed that all of the visitors who were willing to switch to alternative activities in the first year after the ban (2003) would be willing to continue visiting in all future years, while those who did not switch in the first year would not do so in future years either.

Table 2-4. Projected Visitation to BICA in the Absence of the Ban on PWC Use, 2003–2012

Year	PWC Users	Non-PWC Users	Total Visitation
2003	1,572	240,787	242,359
2004	1,588	243,642	245,230
2005	1,604	246,530	248,134
2006	1,620	249,453	251,073
2007	1,636	252,410	254,046
2008	1,652	255,403	257,055
2009	1,669	258,431	260,099
2010	1,685	261,494	263,180
2011	1,702	264,594	266,297
2012	1,719	267,731	269,451

- economic conditions,
- weather,
- water levels and other natural resource conditions,
- national and state regulations that may affect PWC use or prices, and
- alternative recreational activities available.

Although many of these factors are difficult to predict, a recent regulation enacted by the U.S. Environmental Protection Agency (EPA) in 1996 may affect PWC use nationally and in BICA. The 1996 EPA rule for New Gasoline Spark-Ignition Marine Engines[4] (hereafter referred to as the 1996 EPA Marine Engine Rule) requires PWC (and other spark-ignition [SI] marine engine) manufacturers to reduce emissions by 75 percent from the 1998 model year until the 2006 model year (*Federal Register*, 1996). In their analysis of the rule, EPA predicted that the emissions from all of the regulated engines in use will decrease by approximately 75 percent from baseline emission levels by the year 2025. The delay in actual emission reductions for machines in use is due to the long lives of some marine engines. EPA predicts that complete fleet turnover for some engines may not occur until 2050. However, EPA assumes that the life cycle for PWC is 10 years, considerably shorter than their assumptions for the life cycles of some of the other SI marine engines covered by the rule (*Federal Register*, 1996). According to the Personal Watercraft Industry Association (PWIA), PWC manufacturers have already reduced the emissions of PWC significantly, and many of the newer PWC models already comply with the 1996 EPA Marine Engine Rule (PWIA, 2002).

Without additional data, it is difficult to predict whether NPS's assumptions will bias the projections upward or downward.

It is also possible that publicity surrounding the proposed NPS PWC rules may have affected PWC use. PWC sales have been declining nationally over the past few years. However, the sales decline began in 1996, which is before NPS first proposed rules restricting PWC in national parks. This suggests that other factors also may be involved in the national recent sales decline. Nonetheless, it is

[4]In 1996, EPA promulgated a rule to control exhaust emissions from new spark-ignition marine engines, including outboards and PWC. Emission controls provide for increasingly stricter standards beginning in model year 1998, with all PWC manufactured after 2006 required to be EPA emissions-compliant (i.e., to reduce hydrocarbon emissions by 75 percent from unregulated levels) (*Federal Register*, 1996).

possible that baseline PWC use would have been higher in the absence of recent negative publicity.

NPS identified the following additional uncertainties in the projections of baseline visitation:

- The estimate of 2001 PWC use represents the park's best estimate of use.
- NPS estimates of total visitation to BICA are based on traffic counters and an assumed group size of 3.5 people per party. To the extent that the actual average group size differs from 3.5 for either overall visitation or PWC users in particular, visitation estimates for these groups may be biased upward or downward.
- NPS projects growth in non-PWC visitation based on population growth in the surrounding counties and in nearby metropolitan areas. As discussed above, a number of factors could affect visitation in any one year or the trend in visitation over time. However, NPS believes that regional population growth, which should be related to economic conditions, represents the best available proxy for change in visitation.
- NPS makes assumptions about the number of former PWC users who will return in the future under the existing ban. These assumptions represent our best estimate, but the actual percentage of former PWC users who continue to visit the park for alternative recreation activities may be higher or lower.
- NPS expects that PWC use at BICA will grow at an annual rate of 1 percent over time. As explained earlier, PWC registrations in Montana and Wyoming increased more sharply than 1 percent per year from 1998 to 2001, although registrations increased at a decreasing rate in both states over this period. Consequently, future PWC use may be underestimated here. However, without further information, such as a formal count of PWC over time at BICA, NPS assumes that the growth rate estimated in the EA of PWC use at BICA (NPS, 2003) is the most accurate basis for predicting future use.

2.3 ALTERNATE LOCATIONS FOR PWC USE IN THE BIGHORN CANYON REGION

BICA reportedly was the primary destination for PWC users in the area, although several areas that permit PWC use are located within 200 miles of BICA. In Wyoming, these include the following (approximate distance to Lovell, Wyoming, located near the southern end of BICA; and closest town in parentheses): Buffalo Bill Reservoir (52 miles; Cody, Wyoming); Boysen Reservoir (123 miles; Thermopolis, Wyoming); Ocean Lake (180 miles; Riverton, Wyoming); and Pilot Butte Dam (183 miles). Alternate locations for

PWC use in Montana include (approximate distance to Saint Xavier, located at the northern tip of BICA; and closest town in parentheses) the Tongue River Reservoir (90 miles; Decker, Montana) and Cooney Reservoir (150 miles; Columbus, Montana).

2.4 OTHER MAJOR SUMMER ACTIVITIES IN BICA

Summer recreation activities in BICA include fishing, boating, hiking, backpacking, mountain biking, hunting, bird watching, nature viewing, picnicking, and visiting historic sites. At Horseshoe Bend and Ok-A-Beh landings, fishing, swimming, and picnicking are popular. Hunting of upland game birds, doves, waterfowl, and big game is permitted in the Yellowtail Wildlife Habitat, located near the southern end of BICA.

2.5 NATURAL RESOURCES AND LIKELY ECOLOGICAL IMPACTS OF PWC USE IN BICA

The following section summarizes key information regarding natural resources at BICA and an assessment of the potential impacts to park resources under the proposed PWC management alternatives identified in Section 1.4. Interviews with BICA personnel and data from the EA for BICA provide the basis for this analysis. Details of the analysis, including guiding regulations and policies, methodologies, and assumptions, are described in the *Bighorn Canyon National Recreation Area Personal Watercraft Use Environmental Assessment* (NPS, 2003). The EA characterizes impacts as negligible, minor, moderate, and major (the definitions of which are specific to the resource being assessed), and the details are provided in the EA. Cumulative impacts associated with the alternatives are addressed only when the results differ from the impacts of PWC use alone.

2.5.1 Water Quality

Most research on the effects of PWC use on water quality focuses on the impacts of two-stroke engines and assumes that impacts caused by these engines also apply to the PWC powered by them. The typical conventional (i.e., carbureted) two-stroke PWC engine takes a mixture of air, gasoline, and oil into the combustion chamber and expels exhaust gases and unburned fuel (as much as 30 percent of fuel intake [California Air Resources Board, 1999]) from the combustion chamber. At common fuel consumption rates,

an average 2-hour ride on a PWC may result in the discharge of 3 gallons (11.34 liters) of fuel into the water (VanMouwerik and Hagemann, 1999).

Contaminants released into the environment because of PWC use include those present in the raw fuel itself and those formed during fuel combustion. Fuel used in PWC engines contains many hydrocarbons (HCs), including volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX) and methyl tertiary butyl ether (MTBE). Unburned PWC fuel does not contain appreciable levels of polycyclic aromatic hydrocarbons (PAHs), but several PAHs are formed as a result of its combustion (i.e., phenanthrene, pyrene, chrysene, benzo(a)pyrene, and acenaphthylene) (VanMouwerik and Hagemann, 1999). Other HC by-products of incomplete combustion are formaldehyde, acetaldehyde, diesel particulate matter (PM), and 1,3-butadiene (EPA, 1994).

Unburned fuel and combustion by-products are released to the environment in PWC exhaust. Because of differences in chemical and physical characteristics, BTEX released into the water readily transfers from water to air, whereas most PAHs and MTBE remain in the water. Therefore, water quality issues associated with BTEX in the water column are less critical than those associated with PAHs and MTBE (VanMouwerik and Hagemann, 1999).

Compounds released in water because of PWC use are known to cause adverse health effects in humans and aquatic organisms. Exhaust emissions from two-stroke engines specifically have been shown to cause toxicological effects in fish (Tjarnlund et al., 1995, 1996; Oris et al., 1998). Sunlight can further increase the toxic effect of PAHs to aquatic organisms (Mekenyan et al., 1994; Arfsten, Schaeffer, and Mulveny, 1996). Research evaluating the possible phototoxic effects of some PAHs to aquatic organisms (NCER, 1999) has demonstrated that toxicity may vary as a result of a number of factors, including length of exposure, turbidity, levels of humic acid and organic carbon, location of the organism relative to water or sediment surface, and weather (NCER, 1999). For example, increased turbidity and organic carbon levels tend to reduce toxicity, while increased length of exposure and decreased distance to water surface tend to increase toxicity of fuel-related compounds.

New PWC engines, including direct-injection two-stroke engines and four-stroke engines, will decrease the amount of unburned fuel that escapes with PWC exhaust and will result in decreased emissions (VanMouwerik and Hagemann, 1999). As a result of the 1996 EPA rule requiring cleaner SI marine engines,[5] a 50 percent reduction of current HC emissions from these engines is expected by 2020, and a 75 percent reduction in HC emissions is expected by 2025 (*Federal Register*, 1996).

Baseline Water Quality Conditions at BICA

The Wyoming Department of Environmental Quality (WDEQ) lists standards for priority pollutants applicable to waters in Wyoming according to the classification defined for the specific water body, which for Bighorn Lake is Class 2AB. Waters in Class 2AB are held to the "Fish and Drinking Water" standard for human health. Wyoming and Montana standards are provided for typical gasoline organic constituents such as benzo(a)pyrene, naphthalene, benzene, and MTBE. The Wyoming standard for benzo(a)pyrene of 0.0044 µg/L is less restrictive than the EPA human health criteria of 0.0038 µg/L. However, the Wyoming standard for benzene of 1.2 µg/L is more restrictive than the EPA human health criteria of 2.2 µg/L. The Montana human-health based standard for benzo(a)pyrene (0.044 µg/L), and benzene (5 µg/L) are both less restrictive than the EPA human health criteria. The Montana standard for naphthalene of 100 µg/L is less restrictive than the ecotoxicological benchmark standard of 62 µg/L. There is no EPA human health benchmark for MTBE, but the Montana standard is 30 µg/L (NPS, 2003).

According to the Water Resources Management Plan for BICA (Jacobs, Peters, and Sharrow, 1996), overall water quality in Bighorn Lake ranges from eutrophic in the upper pool region near Yellowtail Dam (at the South end of BICA) to mesotrophic further from the upper pool. Horseshoe Bend and Barry's Landing (two of the three paved boat launch sites) are located in the southern eutrophic

[5]In 1996, EPA promulgated a rule to control exhaust emissions from new SI marine engines, including outboards and PWC. Emission controls provide for increasingly stricter standards beginning in model year 1998, with all PWC manufactured after 2006 required to be EPA emissions compliant (i.e., to reduce HC emissions by 75 percent from unregulated levels) (*Federal Register*, 1996).

region. Phosphorous input from nonpoint sources (e.g., agricultural, grazing, and forest land runoff) and point discharges of industrial and municipal waste are believed to be the primary factors driving summer phytoplankton growth (eutrophication) in the reservoir (NPS, 2003). According to Jacobs, Peters, and Sharrow (1996), levels of nitrate and ortho-phosphate are "relatively high in the reservoir compared to average natural waters" and also promote algal blooms in the lake.

PCB levels in sediment, water, and fish samples collected in 1992 were below detection levels. The same study found "moderately high" mercury concentrations in walleyed pike, although mercury in Bighorn Lake is attributed to natural rock weathering in the area and not to human activity (Jacobs, Peters, and Sharrow, 1996).

Sediment accumulation rates in Bighorn Lake are very high, particularly in the south (upper) end of the reservoir. The Soil Conservation Service estimates that 4,000 tons of sediment are deposited each day in the upper portion of the reservoir. Sediment trapping has improved recreational fishing conditions below the Yellowtail and Afterbay Dams but can prevent watercraft launching from Horseshoe Bend (the only developed access point in Wyoming) when water levels are low (Jacobs, Peters, and Sharrow, 1996).

According to NPS, emissions from boats may affect water quality in areas of heavy use and/or shallow water (e.g., boat launches, creek areas). However, this has not been studied.

Because PWC are currently banned from BICA, they have no impact on water quality.

Overall, the impact of current PWC use on water quality at BICA appears to be limited.

Potential Impact of PWC Use on Water Quality Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. Overall, the impact of historic PWC use on water quality at BICA appears to be limited because of the small number of PWC relative to other watercraft (less than 5 percent of total watercraft); the short length (3 months) of the PWC season; and the fact that water quality is affected by non-PWC–related stressors, particularly sediment, phosphorous, and nitrogen influx.

Based on modeling results, NPS concluded that PWC use as managed through November 2002 would result in pollutant loads well below ecotoxicological and human health benchmarks identified above and thus that impacts would be negligible (NPS, 2003). NPS concludes that Alternative A would not result in an impairment of water resources.

In addition, any impacts to water quality from motorized vessels in general are expected to lessen as manufacturers meet EPA requirements to improve engine efficiency by 2006 and conventional engines are replaced with direct-injected two-stroke or four-stroke models.

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. Impacts to water quality from Alternative B are expected to be similar to Alternative A. Closure of the South Narrows is not expected to provide benefits to water quality relative to Alternative A because water levels in this area are generally below the elevation of launch facilities in an average year (NPS, 2003).

Alternative C: No-Action (Continue PWC Ban). No impacts to water quality from PWC would occur within BICA if the ban continued.

2.5.2 Air Quality

Air quality and visibility can be affected by emissions from two-stroke engines such as PWC motors. Emissions from PWC in national parks are one of many potential (albeit relatively small) sources of these air quality and visibility impairments.

Recreational marine engines, including PWC and outboard motors, contribute approximately 30 percent of national nonroad engine emissions and are the second-largest source of nonroad engine HC emissions nationally (*Federal Register*, 1996). According to the results of a 1990 inventory of emissions in California, watercraft engines produced an estimated 141 tons of smog-forming reactive organic gases (ROG), 1,063 tons of carbon monoxide (CO), and 31 tons of nitrogen oxides (NO_x) per day (Kado et al., 2000). A comparison of emissions from conventional and direct-injection two-stroke engines with emissions from four-stroke engines found that the new four-stroke engines had considerably lower emissions

of PM, PAHs, and substances with genotoxic activity (Kado et al., 2000). Based on a comparison with a typical 90-horsepower engine, it is estimated the ban of conventional two-stroke engines would result in a four-fold decrease in smog-forming pollution per engine (VanMouwerik and Hagemann, 1999).

Up to one-third of the fuel delivered to conventional two-stroke engines remains unburned and is discharged as part of the waste stream.

Although PWC engine exhaust is usually routed below the waterline, some of the exhaust gas is released to the air and may affect air quality. The combustion process results in emissions of air pollutants such as HCs (PAHs and VOCs such as BTEX and MTBE), NO_x, PM, and CO (Kado et al., 2000). PWC also contribute to the formation of ozone (O_3) in the atmosphere, which is formed when HCs react with NO_x in the presence of sunlight (EPA, 1993). Additionally, up to one-third of the fuel delivered to conventional two-stroke engines remains unburned and is discharged as part of the waste stream. The lubricating oil also is used once and is expelled as part of the exhaust. Some of the compounds (e.g., VOCs) in the unburned fuel may transfer from water to air and become air pollutants. (See Section 2.5.1 for further discussion of burned and unburned constituents of PWC emissions.)

Several compounds in PWC exhaust are known to adversely affect both human and plant life. They may adversely affect park visitor and employee health, as well as sensitive park resources. O_3 causes respiratory problems in humans, including coughing, airway irritation, and chest pain during inhalation. O_3 also is toxic to sensitive species of vegetation. It causes visible foliar injury, decreased plant growth, and increased plant susceptibility to insects and disease (EPA, 1993). CO can interfere with the oxygen-carrying capacity of blood, resulting in insufficient oxygenation of tissues. Adverse health effects have been associated with exposure to airborne PM, especially PM less than 10 µm aerodynamic diameter (PM10) (Kado et al., 2000). NO_x contributes to acid deposition effects on plants, water, and soil. NO_x and PM emissions associated with PWC use can reduce visibility and thus visitor enjoyment.

Baseline Air Quality Conditions at BICA

BICA is subject to federal, Wyoming, and Montana air regulations and is managed as a Class II airshed. Ambient air pollutant concentrations for the recreation area are believed to be within

national and state air quality standards because of the relatively low population density near the recreation area (NPS, 2003). No exceedances of six criteria air pollutants (CO, O_3, NO_x, SO_x, PM10 and PM2.5, and Pb) were reported at the nearest monitoring stations—in Bighorn County, Montana, or Bighorn County, Wyoming, between 1996 and 2001 (EPA, 2002). Visibility (as measured by PM2.5) in the area of BICA is considered good (NPS, 2003).

Currently there is no impact to air quality from PWC operating within BICA because they are banned from the park.

Potential Impact of PWC Use on Air Quality Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. NPS anticipates that air quality and air quality-related values would not be impaired under Alternative A. Based on estimates of annual emissions, NPS anticipates that Alternative A would result in negligible human health impacts from CO, PM10, HC, NO_x, and PAH. In addition, PWC use under Alternative A would have no perceptible visibility impacts, and no ozone injury on plants has been observed (NPS, 2003).

Overall, cumulative adverse impacts to human health from airborne pollutants in 2002 would be minor for CO and like PWC, negligible for PM_{10}, HC, and NO_x. Combined emissions of CO would by 2012 because two types of cleaner (i.e., reduced HC) outboard engines—fuel injection two-stroke and four-stroke—have higher CO emissions than the carbureted two-stroke engines. As boating increases annually and two-stroke engines are replaced with these cleaner engines, CO emissions would increase. However, the cumulative adverse impacts to human health from airborne pollutants in 2012 would be negligible for PM_{10}, HC, and NO_x, and minor for CO. In contrast, localized improvements in air quality from reduced HC emissions are likely to be gradual as manufacturers meet EPA requirements to improve the engine efficiency by the year 2006 and conventional engines are replaced with direct-injected two-stroke or four-stroke models. Like PWC, the cumulative adverse impacts to air quality-related values at BICA would be negligible (NPS, 2003).

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. NPS anticipates that air quality and air quality-related values would not be impaired under Alternative B. PWC-related and cumulative impacts are expected to be similar to Alternative A, because the closure of the reservoir and shoreline area south of the South Narrows is not expected to affect the number of PWC using the reservoir (NPS, 2003).

Although geographic restrictions on PWC use in BICA are unlikely to significantly affect air quality, as with Alternative A, some improvements in local air quality could result as EPA-compliant, direct-injection or four-stroke models gradually replace inefficient two-stroke engines.

Alternative C: No-Action (Continue PWC Ban). No impacts to air quality or related values from PWC would occur within BICA if the ban continued.

2.5.3 Soundscapes

PWC emit up to 105 dB per unit at 82 feet, which may disturb park users and wildlife. NPS has established a noise limit for all watercraft of 82 dB at 82 feet. Noise from PWC may be more disturbing than noise from a constant source at 90 dB due to rapid changes in acceleration and direction of noise (EPA, 1974) and their ability to be driven in shallow water close to the shoreline. However, the newer EPA 2006-compliant models of PWC may be up to 50 to 70 percent quieter than the older models (PWIA, 2002b).

Baseline Soundscape Conditions at BICA

According to park officials, there is a relatively high noise level in BICA because of the steep canyon walls and prevalence of boats.

One aspect of experiencing BICA's resources is the ability to hear the sounds associated with its natural resources, often referred to as "natural sounds" or "natural quiet." According to park officials, there is a relatively high noise level in BICA because of the steep canyon walls and prevalence of boats (most visitors use some type of boat, and two of the designated campgrounds on Bighorn Lake are boat-in). Typical sounds at BICA include watercraft, automobiles, trucks, radios, waves, wind, bird songs, and visitors talking. According to NPS (2003), human sounds are not unexpected or inappropriate at the recreation area but are a part of the overall soundscape in an area where water activities, picnicking, camping, sightseeing, and

other recreation use are part of the purpose of the national recreation area. No studies have documented visitor complaints about noise or the effects of noise on wildlife (NPS, 2003).

PWC are currently banned from the park and therefore have no impact on the natural soundscape of BICA.

Potential Impact of PWC Use on Soundscape Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. NPS anticipates that the soundscape would not be impaired under Alternative A. Overall, NPS expects that noise from PWC would have short-term, minor to moderate adverse impacts at certain locations along the lake on days of heavy PWC use. Minor adverse impacts would occur at times and places where use is infrequent and distanced from other park users, for example, as PWC users operated far from shore. Moderate adverse impacts would occur at landings on the lake on days of relatively consistent PWC operation with more than one PWC operating at one time. Moderate adverse impacts would occur from highly concentrated PWC use in one area and in areas where PWC noise is magnified by reflection off the surrounding cliffs. Moderate adverse impacts would also occur if PWC users operate in areas of BICA that are away from launch areas and campgrounds and where shoreline visitors would be anticipating a quiet, wilderness experience (NPS, 2003). As industry standards for PWC engines change, quieter PWC will become the norm and noise generated by PWC is expected to decline.

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. NPS anticipates that Alternative B would not result in the impairment of the natural soundscape of BICA and that impacts would be similar to Alternative A (NPS, 2003). Geographic restrictions in Alternative B would result in the elimination of PWC noise experienced by park visitors in the areas south of the South Narrows; however, because PWC use is already limited in this area, beneficial impacts from a reduction of PWC noise relative to Alternative A would be negligible (NPS, 2003).

Alternative C: No-Action (Continue PWC Ban). No impacts to the natural soundscape from PWC would occur within BICA if the ban continued.

2.5.4 Wildlife and Wildlife Habitat

PWC may affect wildlife by interrupting normal activities, inducing alarm or flight responses, causing animals to avoid habitat, and (potentially) impairing reproductive success. These effects are thought to be caused by a combination of PWC speed, noise, and ability to access sensitive areas, particularly in shallow water (WDNR, 2000). PWC can access sensitive shorelines and disrupt riparian habitats critical to wildlife. When run in very shallow water, PWC can disturb the substrate, including aquatic plants, benthic invertebrates, and, at certain times of the year, breeding and spawning areas for fish.

Waterfowl and nesting birds may be particularly affected by PWC noise, speed, and their unique ability to access shallow water. This may force nesting birds to abandon eggs during crucial embryo development stages; keep adults away from nestlings and thus prevent them from defending the nest against predators; and flush other waterfowl from habitat, causing stress and associated behavior changes (WDNR, 2000; Burger, 1998; Rodgers and Smith, 1997).

Baseline Wildlife and Wildlife Habitat Conditions at BICA

There are currently no adverse impacts to wildlife populations from PWC in BICA because they are banned in the park. The ban also eliminates any potential impacts to wildlife resulting from PWC-associated noise or emissions.

According to NPS (2003), there are 47 species of mammals, 28 species of fish, approximately 20 reptiles and amphibians, and approximately 212 species of birds found in BICA. Wildlife uses the range of habitats found in the park, including lacustrine (Bighorn Lake), riverine (more than 18 rivers and streams feeding in to Bighorn Lake), juniper woodland, and pine and fir woodland.

Habitat. There are four distinct vegetative or climatic zones in BICA, according to NPS officials and online information (Anglers Edge, 2002). The south end of BICA contains desert shrub land, and the middle section of BICA contains juniper woodland. Pine and fir

woodland is found along the sides of the steep canyons,. In the north is short grass prairie. The Yellowtail Wildlife Habitat is in the southern reaches of BICA below Horseshoe Bend.

Mammals. According to NPS (2003), the common mammal species in BICA include mule deer, white-tailed deer, beavers, marmot, porcupine, skunks, badger, bobcat, mink, and muskrat. Black bear and mountain lions are not common but are sighted every year. Wild horses, reintroduced by European settlers in the 1400s, are also located in BICA.

Birds. NPS (2003) has identified the aquatic and riparian habitats of BICA as especially important to birds during the fall migration. Of the more than 200 species, the majority are songbirds. Other species include large raptors, large and small waterfowl, and shorebirds.

Fish. Approximately half of the fish community in BICA is native, and the remainder were introduced (NPS, 2003). Native species include sauger, channel catfish, suckers, black bullhead, cutthroat trout, chub, and minnows. Stocked fish have include walleye, rainbow, lake, and brook trout, sockeye salmon, and white crappie, although only walleye have been stocked in recent years.

Amphibians and Reptiles. Five species of amphibians are native to BICA: blotched tiger salamander, boreal chorus frog, northern leopard frog, Woodhouse's toad, and plains spadefoot toad. Wetlands provide the most important habitat for amphibians within BICA (NPS, 2003).

Aquatic Invertebrates. Studies of aquatic invertebrates in BICA are limited, and NPS anticipates that fluctuating water levels, turbidity, and siltation limit the development of extensive aquatic invertebrate communities (NPS, 2003).

Overall, there is very little information available on possible effects of PWC on wildlife in BICA.

Potential Impact of PWC Use on Wildlife and Wildlife Habitat Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. NPS anticipates that wildlife and wildlife habitat would not be impaired under Alternative A. No known adverse impacts on wildlife in BICA are associated with historical PWC use; specifically there are no documented cases of deliberate harassment or PWC-wildlife collisions on the lake. In addition,

access by PWC in shoreline areas is primarily limited to launch areas and campgrounds (NPS, 2003).

With respect to specific wildlife groups, NPS anticipates that impacts to mammals would be negligible to minor because most species are rarely found in the shoreline areas, and aquatic mammals are able to move away from areas of PWC use. Breeding habitat for birds does not tend to overlap with areas of PWC use, so adverse impacts to birds are expected to be negligible to minor. As discussed in Section 2.5.1, PWC use under Alternative A is not expected to result in exceedances of ecotoxicological benchmarks; thus, impacts to fish or aquatic invertebrates would likely be negligible to minor. Similar to the case for birds, there is no known overlap between amphibian and reptile nesting and breeding sites and areas of PWC use, and thus impacts to these animals is expected to be negligible.

NPS anticipates that the cumulative adverse impacts to wildlife and wildlife habitat from visitors engaging in multiple activities, including PWC use under Alternative A would be minor to moderate but short term.

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. NPS anticipates that Alternative B would not result in the impairment of the wildlife or wildlife habitat in BICA and that PWC-specific and cumulative impacts would be similar to Alternative A (negligible to minor) (NPS, 2003). NPS anticipates that implementing a user education program would reduce the likelihood of user and wildlife conflicts by increasing the awareness of potential conflicts. Although PWC use south of the South Narrows has historically been limited, this geographic restriction could make any impacts to wildlife in these areas less than those predicted in Alternative A.

Alternative C: No-Action (Continue PWC Ban). No impacts to wildlife or wildlife habitat from PWC would occur within BICA if the ban continued.

Current Conditions for Threatened, Endangered, and Special Concern Species

Eleven animal and plant species listed by the US Fish and Wildlife Service as threatened and endangered, or by Montana or Wyoming as species of special concern, may occur in BICA: bald eagle, mountain plover, American peregrine falcon, Rocky Mountain bighorn sheep, Townsend's big-eared bat, northern leopard frog, plains spadefoot toad, Hapeman's sullivantis, Lesica's bladderpod, persistent sepal yellowcress, and sweetwater milkvetch. Of these, only the bald eagle, peregrine falcon, bighorn sheep, leopard frog, and yellowcress have habitat at the shoreline. Although observed in substantial numbers in the park in winter, bald eagles are not known to nest on or near the reservoir. Peregrine falcons have been observed nesting near Devil Canyon Overlook (between Barry's Landing and Horseshoe Bend) (NPS, 2003). The estimated size of the bighorn sheep herd in BICA in 2000 was 85 to 105 animals, whereas minimum viable population size is considered to be 300 to 350 animals (*Billings Gazette*, 2002). Bighorn sheep inhabit the steep canyon sides and are believed to reproduce in the Devil Canyon Overlook Area.

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. NPS anticipates that threatened and endangered species would not be impaired under Alternative A (NPS, 2003). Specifically, NPS does not anticipate any adverse effects to any species identified as of concern. As indicated above, there are no documented cases of deliberate harassment or PWC-wildlife collisions on Bighorn Lake.

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. NPS anticipates that Alternative B would not result in the impairment of the threatened and endangered species in BICA, and that impacts would be similar to Alternative A (negligible to minor; NPS, 2003). NPS anticipates that the implementation of a user education program would reduce the likelihood of user and wildlife conflicts by increasing the awareness of potential conflicts. An additional benefit of Alternative B relative to A is that PWC would be restricted from the southernmost portion of Bighorn Lake, here bald eagles and persistent sepal yellowcress are known to occur (NPS, 2003).

Alternative C: No-Action (Continue PWC Ban). No impacts to threatened and endangered species from PWC would occur within BICA if the ban continued.

2.5.5 Shorelines and Shoreline Vegetation

PWC use can potentially adversely affect the shoreline habitat including the shoreline, shoreline vegetation, and submerged aquatic vegetation (SAV) beds. Shoreline and shoreline vegetation are critical to the juvenile stages of fish and general overall habitat for a variety of aquatic organisms, including fish and shellfish, and waterfowl species. SAV beds are also critical to aquatic organisms. SAV beds reduce wave action, support nursery fish, provide protection from predators, stabilize sediment, and provide food for many species.

PWC can affect shoreline and shoreline vegetation because they are able to access areas where most other watercraft cannot go due to their shallow draft. As a result, PWC may land on the shoreline allowing visitors to access and disturb areas where sensitive plant species exist. In addition, wakes created by PWC may cause erosion and thus affect shorelines. Turbulence from boat propellers near the shoreline can also erode the shoreline by destabilizing the bottom (WDNR, 2000).

PWC use can also affect SAV by increasing turbidity, which may result in decreased sunlight available for SAV, limit vegetation growth, and ultimately decrease water quality. PWC use in shallow water supporting SAV may reduce its value as important habitat for animals by redistributing the plants and organisms that use these grasses for habitat.

Baseline Condition of Shorelines and Shoreline Vegetation at BICA

Because of water level fluctuations from reservoir operations and the steep-walled canyons constituting the majority of the shoreline of Bighorn Lake, substantial areas of shoreline vegetation are lacking from BICA (NPS, 2003).

Potential Impact of PWC Use on Shorelines and Shoreline Vegetation Under the Proposed Alternatives

Alternative A: Reinstate PWC Use as Previously Managed Under a Special Regulation. NPS anticipates shorelines and shoreline vegetation would not be impaired under Alternative A. PWC use would result in negligible short-term adverse effects on shoreline vegetation because of low PWC use and the lack of shoreline vegetation resulting from the canyon environment present throughout the majority of the national recreation area. According to visitor use patterns, sensitive wetland and riparian communities are located in areas not often used by PWC due to accessibility issues related to water-level cycles (NPS, 2003).

NPS anticipates that cumulative adverse impacts from other watercraft (which account for almost 96 percent of all boating use at BICA) and other visitor activities would be negligible to minor and short-term. In addition, lake level fluctuations from drought or lake operations would have potentially minor to moderate adverse impacts to sensitive vegetation in the Yellowtail Wildlife Habitat area (NPS, 2003).

Alternative B: Reinstate PWC Use as Previously Managed Under a Special Regulation with Additional Management Prescriptions. NPS anticipates that Alternative B would not result in the impairment of shorelines and shoreline vegetation in BICA, and that PWC-related and cumulative impacts would be similar to Alternative A (NPS, 2003). NPS believes that the closure of the area south of the South Narrows would have potential benefits to the wetland and riparian communities during times when water levels are sufficient for PWC access, and that the user education program would increase the awareness of visitors to the importance of these vegetation communities (NPS, 2003). Any impacts from PWC use to shorelines and sensitive shoreline vegetation would remain negligible, adverse, and short term.

Alternative C: No-Action (Continue PWC Ban). No impacts to shorelines and shoreline vegetation from PWC would occur within BICA if the ban continued.

2.6 ECONOMIC ACTIVITY IN THE SURROUNDING COMMUNITIES

The area surrounding BICA is very rural. Along with agriculture and mining, tourism is the largest industry in the area. Billings is the largest town in the region, but the small towns of Fort Smith and Warren in Montana and Frannie, Deaver, Lovell, Byron, and Powell in Wyoming are also within 75 miles of BICA.

Only three businesses within a 100-mile radius of BICA sell PWC.

Because of the small number of PWC used in BICA prior to the ban relative to motorboats (less than 5 percent of total watercraft in BICA), the presence of other reservoirs and lakes within 200 miles of BICA that allow PWC, and the diversity of recreational activities in the area, the PWC industry in the vicinity of BICA is relatively small. According to NPS personnel, only three businesses within a 100-mile radius sell PWC. All three are located in Billings, Montana (75 miles away). One of these businesses also rented PWC to BICA visitors prior to the November 2002 ban.

3 Economic Impact Analysis of Alternatives for Managing PWC Use in Bighorn Canyon National Recreation Area

Reinstating PWC use in BICA may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, allowing PWC in the park is expected to increase economic activity in the areas surrounding the park. However, the incremental impacts are very small relative to the size of the local economy.

Historically, PWC use has been a relatively minor recreational activity in BICA. In 2001, an estimated 0.651 percent of annual visitors used PWC in the park. Thus, although reinstating PWC use in BICA could have a positive economic impact on the surrounding area, any impact is likely to be small. The primary economic impacts associated with Alternatives A and B are the potential increases in the sales, profits, and employment of PWC sales and rental shops, restaurants, and other businesses that serve PWC users visiting BICA relative to baseline conditions (ban). The total impact of each alternative will depend in large part on the response of the affected individuals and firms to the ban on PWC use in BICA. To the extent that affected local retailers were able to provide substitute products and services, they may have been able to reduce the negative impact on their profits associated with the November 2002 ban. In addition, some former PWC users may have continued to visit BICA to participate in other recreational activities. It is also possible that visitation to BICA by non-PWC users increased following the ban on PWC use if the restrictions made park visitation more enjoyable for this group of people. The more that producers and PWC users made adjustments to mitigate the

negative impacts of the ban, and the more that non-PWC users increased their visitation, the smaller the positive economic impacts of reinstating PWC use at BICA.[1]

This section summarizes the incremental regional economic impacts associated with the proposed alternatives for managing PWC use in BICA. The majority of the economic impacts are expected to be concentrated in the counties surrounding the park.[2] Thus, projected changes in economic activity are compared to the size of the county economies to place the impacts in perspective.

3.1 SCENARIOS EXAMINED IN THIS REPORT

NPS estimates that PWC users accounted for only about 0.651 percent of annual visitation in 2001.

As described in Section 2.2, PWC users accounted for a small fraction of total visitation to BICA prior to the ban in November 2002. NPS estimates that 1,572 visitors used PWC in 2001, accounting for only about 0.651 percent of annual visitation to BICA. Baseline visitation (i.e., with PWC being banned from BICA) was projected through 2012 using a starting point of average annual visitation over the most recent 5 years with data, 1997 to 2001. NPS assumed that the proportion of visitors who used PWC in 2001 was representative of the 1997 to 2001 time period. Baseline non-PWC user visitation was then assumed to increase at a rate equal to the average of the 1990 to 2000 annual population growth rates in counties surrounding the park.[3] Although there would be no PWC use in BICA in 2003–2012 under baseline conditions, it is likely that some former PWC users would continue to visit the BICA region to enjoy other recreational activities.

PWC users are expected to change their visitation to BICA in response to regulations placed on PWC use. To estimate the magnitude of the resulting economic impacts, NPS constructed scenarios for the

[1] A decrease in expenditures for substitute activities in the BICA region in response to allowing PWC use would partially offset any positive regional impacts associated with Alternatives A and B. In addition, there may be reallocation of revenue among businesses.

[2] The two Montana counties around BICA identified for this analysis are Carbon and Bighorn. The Wyoming county identified is Bighorn.

[3] It would be preferable to use population projections rather than assuming that population growth would continue at historical levels. However, the Census Bureau only provides population projections at the state and national levels. Because most BICA visitors come from an area covering parts of several states, NPS believes that the recent historical population growth rate in these areas is a more appropriate basis for projecting population than the projected growth rate for the state.

regulatory alternatives based on the available information. For Alternative A, it is expected that PWC users who previously used PWC in the park would return because PWC use would be managed in the same way as before the 2002 ban. Under Alternative B, PWC users would be able to use their PWC in BICA but would not be allowed to operate PWC south of the South Narrows. Thus, it is assumed that most former PWC users, but not all, will return to visit the BICA region to use PWC. However, of those who do not, some will return to BICA to enjoy other recreational activities or use PWC in nearby substitute areas. Under Alternative C, it is expected that there will be no change in visitation relative to baseline projections because management of PWC in BICA would remain unchanged relative to current conditions.

It is assumed that people who resume visiting the BICA area will have the same spending patterns as current visitors, except that some of them will resume renting PWC. It is possible that some visitors who currently engage in summer recreational activities other than PWC use would reallocate spending on those activities towards expenditures on PWC use. However, because there is no specific data available on spending by users engaging in different types of recreation, this potential spending change is not included in the analysis.

To better develop the economic impact scenarios, NPS interviewed PWC sales and rental shop owners identified in the area concerning the expected impacts on those businesses. The universe of affected entities was identified by visiting the BICA area and contacting potentially affected businesses. In addition, NPS used secondary sources such as *InfoUSA* (2002) to help identify businesses in the region that may have revenues related to PWC use in BICA. These shops were interviewed prior to the ban on PWC use in November 2002. At that time the establishments generally expressed some concern that restrictions on PWC use would cause a reduction in sales as a result of negative publicity. Some shops indicated that sales had already fallen because of concerns about future restrictions on PWC use in BICA. All of the firms interviewed predicted very significant declines in PWC-related revenue as a result of the no-action alternative, with up to 100 percent losses of PWC-related revenue. Consequently, if PWC use is reinstated in BICA, these businesses are expected to regain up to 100 percent of

PWC-related revenues. These predicted impacts for local businesses are discussed in more detail in Section 5.

NPS used information from these interviews to help estimate baseline revenues for firms deriving revenue from PWC use in BICA. In some cases, NPS used estimates of business revenues from *InfoUSA*, which only provides sales ranges. NPS used the midpoint of this range for the analysis, which may understate or overstate the actual revenue of a particular business.

Based on information collected from local businesses and BICA park staff, scenarios were developed for each of the proposed regulatory alternatives. The three primary scenarios analyzed for BICA are summarized in Table 3-1.

Table 3-1. Assumptions Used in Analyzing Economic Impacts of BICA Regulatory Alternatives (%)

	Alternative A	Alternative B	Alternative C
Annual percentage change in the number of visitors using PWC in BICA that would have occurred in the absence of the ban[a]	1%	1%	1%
Baseline annual percentage change in non-PWC user visitation to BICA[b]	1.19%	1.19%	1.19%
Percentage of visitors who used PWC in BICA prior to the ban who are expected to continue visiting the park for other activities[c]	80%	80%	80%
Percentage of visitors using PWC in BICA prior to ban that will resume using PWC in BICA if PWC use is authorized[c]	100%	95%	NA
Percentage of visitors renting PWC for use in BICA prior to ban that will resume renting PWC for use in BICA[c]	100%	95%	NA
Percentage of visitors purchasing PWC for use in BICA prior to ban that will resume purchasing PWC for use in BICA[c]	100%	95%	NA

NA = not applicable

[a]National Park Service (NPS). 2003. *Bighorn Canyon National Recreation Area Personal Watercraft Use Environmental Assessment.* Washington, DC: National Park Service.

[b]Based on regional population growth from 1990 to 2000 (U.S. Census Bureau, 2002).

[c]NPS estimates.

As discussed in Section 2.2, the assumption that PWC use in the future will grow by 1 percent per year is based on the EA for PWC use in BICA (NPS, 2003). For visitors who do not use PWC, visitation to the park was assumed to be increasing at an annual rate equal to the average annual population growth rate over the last decade for the counties surrounding BICA (see Section 2.2.3). That growth rate was 1.19 percent, which is above the national growth rate of 0.9 percent over that time period (Census Bureau, 2002).

It was assumed that PWC visitation to BICA would increase to pre-ban levels under Alternative A, increase to 95 percent of pre-ban levels under Alternative B, and remain at baseline levels under Alternative C.

It was assumed that PWC visitation to BICA would increase to pre-ban levels under Alternative A, increase to 95 percent of pre-ban levels under Alternative B, and remain at baseline under Alternative C. Accordingly, PWC sales revenues and PWC rental revenues are assumed to return to pre-ban levels under Alternative A and 95 percent of pre-ban levels under Alternative B. Under Alternative C, it is expected that there will be no change in PWC sales or rental revenues relative to baseline projections because PWC would continue to be banned in BICA. It should be noted that, under the baseline projections, in which PWC are banned from BICA, park-related PWC rentals were assumed to have declined by 100 percent relative to pre-ban levels and PWC sales are assumed to have declined by 75 percent relative to pre-ban levels.[4]

As described in Section 2.2.3, baseline visitation beginning in 2003 was estimated by assuming that 80 percent of those visitors who previously used PWC in BICA prior to the ban would continue to visit the park to engage in alternative activities. This assumption is based on the fact that BICA is a unique recreational destination in the region and that there are few substitutes in the region for water-based recreation.

To project PWC use from 2003 through 2012 for the alternatives where PWC would be permitted in the park (Alternatives A and B), NPS assumed that PWC use would grow by 1 percent per year. Although that growth rate is below the rate of increase in PWC registrations in Montana and Wyoming in recent years, nationwide sales of new PWC have been declining dramatically since 1995 (see Table 3-2). This would indicate that PWC use may be on the decline nationally. Although it is certainly possible that regional

[4]PWC sales were not assumed to have fallen by 100 percent because it is expected that some area residents would have continued to purchase PWC at these dealerships to use in alternative locations.

Table 3-2. National PWC Sales, 1991–2001 (Number of PWC)

Year	PWC Sales
1991	68,000
1992	79,000
1993	107,000
1994	142,000
1995	200,000
1996	191,000
1997	176,000
1998	130,000
1999	106,000
2000	92,000
2001	83,000

Source: National Marine Manufacturers Association (NMMA). 2002. "Annual Retail Unit sales Estimates." *Boating 2001.* National Marine Manufacturers Association. <www.nmma.org>. As obtained July 11, 2002.

PWC use differs from national trends and state trends, the number of PWC used in the region also appears to be stabilizing. Based on national and regional trends and information from park staff, the number of PWC used in BICA is assumed to grow 1 percent annually through 2012 (NPS, 2003).

The scenarios outlined in Table 3-1 are used in Section 3.2 to provide estimates of potential economic impacts resulting from reinstating PWC use in BICA under Alternative A or B. The fewer former PWC users who would continue to visit BICA under the ban, the longer the overall impact of reinstating PWC use, other things being equal. Thus, the overall economic impact of this regulation depends on the willingness of former PWC users who are prevented by the ban from using PWC in the park to continue visiting BICA to engage in alternative activities.

3.2 IMPACT OF PWC REINSTATEMENT ON LOCAL ECONOMIES

The proposed regulations may affect the local economy in several ways, including changes in park visitation, sales and profits of local businesses, local employment, and local and state sales tax revenue. Generally, reinstating PWC use in BICA is expected to increase

economic activity slightly in the areas surrounding the park relative to baseline conditions. The following sections describe the estimated economic impacts on the region where the majority of the effects from increased visitation to BICA will be felt.

3.2.1 Effect of Management Alternatives on Visitation to BICA Area

Generally, reinstating the use of PWC in BICA is expected to increase economic activity slightly in the areas surrounding the park.

Alternatives A and B are expected to lead to an increase in the number of visitor-days spent in BICA compared with the projected baseline, as shown in Table 3-3. This anticipated increase in the number of visitor-days is primarily due to the expectation that some people who used PWC in the park prior to the ban will increase their visitation to BICA relative to the baseline if PWC use is reinstated. The actual increase in park visitation depends on several factors. Some people who previously used PWC in BICA may have chosen to continue visiting the park after the ban on PWC use to enjoy alternative summer activities available within BICA, such as hiking, boating, and fishing. As mentioned earlier, visitation by non-PWC users may have increased as a result of the ban on PWC use because the absence of PWC may have created a more enjoyable outdoor experience for some members of this group. This increased visitation could partially offset the loss in PWC users but was not quantified in this report because of a lack of data. Consequently, to the extent that non-PWC users increased their visitation to the park as a result of the ban on PWC use, the results of this analysis may have overestimated the change in visitation resulting from regulations that allow PWC to return to BICA.

3.2.2 Effect of Management Alternatives on Local Business Output

As a result of the incremental increases in visitation to the BICA area expected under Alternatives A and B, there will be a corresponding increase in the value of local business output. The primary sectors that are affected by an increase in summer visitation are the tourism sectors, including PWC sales and rental shops, restaurants, and retailers. As discussed in Appendix A, although the direct impact of an increase in visitor spending is primarily felt in these sectors, many additional sectors of the economy will be affected to some extent through secondary impacts. NPS focuses on the impacts for 2003, the first year after implementation of the selected alternative for PWC management.

Table 3-3. Incremental BICA Visitation Under Regulation Relative to Baseline Conditions[a]

	Alternative A			Alternative B			Alternative C[b]		
Year	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation	Former PWC Users that Resume PWC Use[c]	Non-PWC Users[d]	Total Visitation
2003	1,572	–1,258	314	1,493	–1,258	236	—	—	—
2004	1,588	–1,258	330	1,508	–1,258	251	—	—	—
2005	1,604	–1,258	346	1,523	–1,258	266	—	—	—
2006	1,620	–1,258	362	1,539	–1,258	281	—	—	—
2007	1,636	–1,258	378	1,554	–1,258	296	—	—	—
2008	1,652	–1,258	395	1,570	–1,258	312	—	—	—
2009	1,669	–1,258	411	1,585	–1,258	328	—	—	—
2010	1,685	–1,258	428	1,601	–1,258	344	—	—	—
2011	1,702	–1,258	445	1,617	–1,258	360	—	—	—
2012	1,719	–1,258	462	1,633	–1,258	376	—	—	—

[a]NPS generated these estimates using the assumptions in Table 3-1.

[b]NPS assumed that there would be no change in visitation relative to baseline conditions under Alternative C because this alternative maintains baseline PWC management (ban on PWC use in BICA).

[c]This column includes those visitors that used PWC in the park prior to the November 2002 ban who would resume PWC use if it were reauthorized. It includes both former PWC users who were assumed to visit the park for other activities during the ban (who are recategorized from non-PWC users to PWC users in this table) and former PWC users who were assumed to stop visiting the park if they cannot use PWC (their return to visiting the park leads to a net increase in visitation relative to baseline for Alternatives A and B).

[d]These are the former PWC users who were assumed to continue to visit the park to engage in alternative activities under baseline conditions. If PWC use is authorized, these visitors are expected to resume using PWC in the park and are counted as PWC users rather than non-PWC users in the table. Without this adjustment, these visitors would be counted twice.

Impacts in subsequent years will be similar, although they are expected to become slightly larger over time as a result of the projected increase in incremental visitation after 2003 (see Table 3-3). The impact in all years is expected to be very small relative to the size of the local economy.

NPS used information from local businesses on the estimated reduction in revenues expected from the November 2002 ban on PWC use in BICA to estimate the increase in revenues that would occur under alternatives that do not include a ban.

To estimate spending impacts, it is necessary to obtain spending information for use with this study's estimated changes in visitation. No secondary data are available concerning the reduction in the number of PWC rented, sold, and serviced annually that resulted from the November 2002 ban on PWC in BICA. Thus, NPS used information provided by local businesses on pre-ban PWC-related revenues and the estimated reductions in PWC sales and rentals expected from the ban to project the total increase in revenue for these categories that would occur under Alternatives A and B, which allow PWC to return to BICA (i.e., assuming that PWC-related revenues would approach or reach pre-ban levels).

For categories of tourism spending other than direct spending on PWC, spending profiles were used in conjunction with estimated changes in visitation to determine the total change in park-related expenditures. The Money Generation Model (MGM2) is a simple input-output (I-O) model that NPS often uses to estimate local economic impacts associated with national park visitation. It provides generic spending profiles for national parks (see Appendix A and the MGM2 website <http://www.msu.edu/user/stynes/npsmgm/> for more information about economic impact analysis using I-O models).

Based on information collected from BICA staff, most visits to the park are day trips (NPS, 2002b). Absent additional information, NPS assumes 75 percent of visitors are local day users and the remaining 25 percent of visitors are split evenly between nonlocal day users and visitors who stay in a motel within the park, a motel outside the park, a campground within the park, and a campground outside the park. Table 3-4 provides the spending information available from MGM2 for these visitor-type categories to show the range of spending values estimated within this category. Only categories with positive average expenditures for a given visitor category are included in the table under that category. For this

Table 3-4. Generic Spending Profiles for Visitors on Day Trips to National Parks (2001$)[a]

	Spending per Party		
	Low	**Medium**	**High**
Local Day User			
Restaurants and bars	8.64	12.35	16.05
Groceries/take-out	4.33	6.19	8.04
Gas and oil	3.37	4.82	6.27
Other vehicle expenses	0.36	0.52	0.67
Admissions and fees	2.94	4.21	5.47
Clothing	0.69	0.98	1.28
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	4.68	6.68	8.69
Total	**$25.72**	**$36.74**	**$47.76**
Nonlocal Day User			
Restaurants and bars	11.52	16.46	21.40
Groceries/take-out	4.33	6.19	8.04
Gas and oil	6.75	9.64	12.53
Other vehicle expenses	0.54	0.78	1.01
Local Transportation	0.18	0.26	0.33
Admissions and fees	5.15	7.36	9.57
Clothing	1.38	1.96	2.55
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	6.48	9.26	12.03
Total	**$37.03**	**$52.90**	**$68.77**
Motel Inside the Park			
Motel, hotel, cabin, or B&B	66.89	95.56	124.33
Restaurants and bars	24.49	34.99	45.48
Groceries/take-out	4.33	6.19	8.04
Gas and oil	6.07	8.68	11.28
Other vehicle expenses	1.09	1.55	2.02
Local transportation	0.36	0.51	0.67
Admissions and fees	8.10	11.57	15.04
Clothing	2.75	3.93	5.11
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	7.92	11.31	14.71
Total	**$122.70**	**$175.28**	**$227.86**
Camping Inside the Park			
Camping fees	11.27	16.09	20.92
Restaurants and bars	7.20	10.29	13.38
Groceries/take-out	9.38	13.40	17.42
Gas and oil	7.42	10.61	13.79
Other vehicle expenses	0.54	0.78	1.01

(continued)

Table 3-4. Generic Spending Profiles for Visitors on Day Trips to National Parks (2001$)[a] (continued)

	Spending per Party		
	Low	**Medium**	**High**
Camping Inside the Park (continued)			
Local transportation	$0.18	$0.26	$0.33
Admissions and fees	$4.42	$6.31	$8.20
Clothing	2.06	2.95	3.83
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	4.32	6.17	8.02
Total	**$47.49**	**$67.85**	**$88.20**
Motel Outside the Park			
Motel, hotel, cabin, or B&B	56.33	80.47	104.61
Restaurants and bars	27.37	39.10	50.83
Groceries/take-out	7.22	10.31	13.40
Gas and oil	6.07	8.68	11.28
Other vehicle expenses	1.09	1.55	2.02
Local transportation	0.36	0.51	0.67
Admissions and fees	8.83	12.62	16.41
Clothing	4.13	5.89	7.66
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	8.64	12.34	16.04
Total	**$120.73**	**$172.48**	**$224.22**
Camping Outside the Park			
Camping fees	15.49	22.13	28.77
Restaurants and bars	8.64	12.35	16.05
Groceries/take-out	6.49	9.28	12.06
Gas and oil	7.42	10.61	13.79
Other vehicle expenses	0.54	0.78	1.01
Local transportation	0.18	0.26	0.33
Admissions and fees	9.57	13.67	17.77
Clothing	4.13	5.89	7.66
Sporting goods	0.70	1.00	1.29
Souvenirs and other expenses	8.64	12.34	16.04
Total	**$61.81**	**$88.30**	**$114.79**

[a] These values are based on the average expenditures per party for visitors to national parks. However, the number of people per party assumed by MGM2 may differ between visitor segments.

Source: Money Generation Model—Version 2 (MGM2). 2002. <http://www.msu.edu/user/stynes/npsmgm/>. As obtained July 2002.

analysis, the medium[5] estimate was used for all of the spending categories analyzed. Because there is no spending category included that represents boat rentals, purchases, or service, it was assumed that the spending estimates from MGM2 are in addition to spending on PWC rentals, sales, and service related to BICA.

The MGM2 model assumes different party sizes, average lengths of stay, and number of entries into the park for the various visitor groups based on data gathered from several national parks.[6] The spending profile estimates in Table 3-4 were used in conjunction with the estimates of visitation changes presented in Table 3-3 to calculate the direct impacts of each alternative on business revenues presented in Table 3-5.[7]

For Alternative A, PWC rental revenues are estimated to increase by $40,800 relative to the baseline estimate. PWC sales and service revenues are expected to increase by $443,460.[8] Under Alternative B, NPS estimates that PWC rental revenues would increase by $38,760 and PWC sales and service revenues by $413,890, relative to the baseline.[9] Alternative C is expected to have no incremental impact on business revenues because it maintains baseline conditions.

As shown in Table 3-5, the largest direct impact is on establishments offering PWC sales and/or service, accounting for nearly 91 percent of the estimated revenue increases resulting from allowing PWC to return to BICA. The increase in PWC sales and service revenues is followed by PWC rental revenues; restaurants and bars; souvenirs and other retail; groceries/take-out; gas and oil; admissions and fees; motel, hotel, cabin or B&B; clothing; sporting

[5]MGM2 provides spending estimates that they classify as low, medium, and high expenditures.

[6]The model adjusts for multiple entries into the park to avoid counting expenditures for a single party more than once.

[7]Because MGM2 uses different assumptions for group size and multiple entries for each user category, it is not possible to use a constant party size and multiply the spending per party estimates presented in Table 3-4 by the expected changes in visitation in Table 3-3 to get the revenue impacts presented in Table 3-5.

[8]Assuming 50 percent of these revenues are made up by service and 50 percent by new machines, this would represent the purchase of approximately 28 new PWC at $7,800 each.

[9]Estimated impacts on PWC rentals, sales, and service were derived from interview data collected from local firms.

Table 3-5. First Year Direct Impact of Alternatives for Managing PWC Use on Business Revenues in BICA Region Relative to Baseline (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
PWC rentals	$40,800	$38,760	$0
PWC sales/service	$443,460	$413,890	$0
Motel, hotel, cabin or BB	$510	$380	$0
Camping fees	$100	$80	$0
Restaurants and bars	$1,540	$1,160	$0
Groceries/take-out	$730	$550	$0
Gas and oil	$620	$470	$0
Other vehicle expenses	$70	$50	$0
Local transportation	$10	$10	$0
Admissions and fees	$560	$420	$0
Clothing	$160	$120	$0
Sporting goods	$110	$90	$0
Souvenirs and other retail	$810	$600	$0
Total	$489,480	$456,580	$0

[a]All impacts were rounded to the nearest $10. Columns may not sum to totals due to rounding.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

goods; camping fees; other vehicle expenses; and local transportation.

Note that the estimated increases in revenue in Table 3-5 overstate the true direct impact to the region because part of the sales value in the groceries/take-out, gas and oil, clothing, sporting goods, and souvenirs/retail categories goes to individuals and firms outside of the region and thus cannot be considered a gain to the BICA region. Using these changes in revenues as inputs into MGM2, NPS estimated the total regional impacts on output. As discussed in Appendix A, for the retail sector only the retail markup can be included as an increase in regional output for the local area. This explains why the direct effect on the region estimated by MGM2 (reported in Table 3-6) is smaller than the change in revenues provided as input. In particular, because the majority of the revenue reductions occur in PWC sales and only the change of the retail markup is considered to affect regional output, the change in regional output is less than the change in revenue.

Table 3-6. First-Year Total Impacts on Value of Output for BICA Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$229,690	$214,330	$0
Total impact	$320,300	$298,870	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

The impacts of PWC regulation in BICA on regional output are estimated to be approximately 0.05 percent of local personal income under the alternative with the largest positive impact.

In addition to the direct effect of the regulation on the regional economy, the indirect and induced effects (ripple effects on input suppliers and from changes in household income, respectively) are estimated (see Appendix A). The multipliers used for this analysis are those provided in MGM2 for a typical small metropolitan area. Table 3-6 also summarizes the first-year total impacts on the value of output for businesses in the BICA region. In this case, the multiplier effects are moderate. The total impact is about 39 percent larger than the direct effect for both alternatives. The total impact estimated for the three alternatives varies from $0 to $320,300, depending on the alternative chosen for managing PWC use. The level of personal income in 2001 dollars in Bighorn (Wyoming), Carbon, and Bighorn (Montana) counties was about $636 million in 2000 (Bureau of Economic Analysis, 2002). Thus, the impact on regional output of allowing PWC use in BICA is estimated to be approximately 0.05 percent of local personal income under the alternative with the largest positive impact (Alternative A).

3.2.3 Change in Value Added

Another measure of the impact on the local economy is the change in value added as a result of the regulation. Value added is the dollar value contributed to a product at each stage of its production. It is calculated at each stage by subtracting the costs of intermediate goods from the value of the final good to avoid double-counting the value of intermediate goods. It will be a smaller value than output because it excludes the value of intermediate goods, whereas output measures do not exclude all intermediate goods. The output measure only excludes the cost of goods produced in other regions resold by wholesalers or retailers. To calculate these values for BICA, the MGM2 data for value added as a share of total output in

each sector were applied to the estimated changes in local output presented in Table 3-6 to get the direct effect on value added by sector. The MGM2 multiplier for value added in each sector was then applied to estimate the total impact. Table 3-7 provides the total change in value added for the local region as a result of the proposed regulations.

Table 3-7. First-Year Total Impacts on Value Added for BICA Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$113,850	$106,240	$0
Total impact	$227,710	$212,570	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.4 Effect on Personal Income

Personal income is a portion of value added that policy makers are commonly interested in. It comprises employee compensation and proprietor income. Table 3-8 shows how labor income in the BICA region changes as a result of the proposed PWC regulations. This value is smaller than value added because it includes only a subset of the components of value added, but it is often useful to break value added down in this way to estimate the effect on regional personal income. Similar to value added, the direct effect of this component is calculated using the MGM2 data for personal income as a share of output in each sector. The total effect is then calculated by multiplying the direct effect by the personal income multiplier included in MGM2 for each sector.

Table 3-8. First-Year Total Impacts on Personal Income for BICA Region (2001$)[a,b]

	Alternative A	Alternative B	Alternative C[c]
Direct effect	$74,920	$69,910	$0
Total impact	$146,990	$137,310	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.5 Change in Employment

Another potential effect of the alternatives for PWC use in BICA is to increase employment in the sectors affected by the rules. These changes are calculated by MGM2 based on ratios of sales to employment for the affected industries in the BICA area. As a result of the increase in sales anticipated under this regulation, companies may need more employees. The estimated increase in employment ranges from 0 to 7.9 employees, depending on the management alternative. These values are calculated based on MGM2 data on the number of employees per million dollars of output in each industry. Estimated changes in the number of employees are therefore equal to the change in output times the number of employees required per unit of output. Table 3-9 summarizes the results of the employment analysis.

Table 3-9. First-Year Total Change in Employment for BICA Region (number of jobs)[a]

	Alternative A	Alternative B	Alternative C[b]
Direct effect	6.5	6.1	0.0
Total impact	7.9	7.4	0.0

[a]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[b]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.6 Change in Tax Revenue

In addition to impacts on the local businesses operating near BICA, there is also an impact on the state and local governments. There is no state income tax in Wyoming. However, Wyoming has a 4 percent sales tax and Big Horn County, Wyoming, has a 1 percent sales tax. Conversely, there is no state sales tax in Montana, but the state has an income tax ranging from 2 to 11 percent. NPS assumes that the average tax rate paid is the midpoint of this range, or 6.5 percent. There are no local sales or income taxes in Montana. Given the different tax structures in the two states, changes in income tax revenues can be attributed to Montana and changes in sales tax revenues can be attributed to Wyoming. Because NPS lacks data on how much spending related to PWC use in BICA occurs in Wyoming versus Montana, both sales tax revenue in Wyoming and income tax revenue in Montana were calculated assuming all spending by BICA visitors would be taxed. This is a

conservative assumption that likely overstates increases in tax revenue in both states. Even with this conservative assumption, the impacts on state and local tax receipts are quite small (see Table 3-10). State sales taxes for Wyoming are estimated to increase by $0 to $19,580; sales tax receipts for Bighorn County, Wyoming, are estimated to increase by $0 to $4,890; and state income tax revenues for Montana are estimated to increase by $0 to $4,870.

Table 3-10. First-Year Change in State and Local Sales Tax Revenue[a,b]

	Alternative A	Alternative B	Alternative C[c]
State			
Income tax	$4,870	$4,540	$0
Sales tax	$19,580	$18,260	$0
Local			
Sales tax	$4,890	$4,570	$0

[a]All impacts were rounded to the nearest $10.

[b]NPS generated these estimates using the MGM2 model (MGM2, 2002).

[c]NPS assumed there would be no impacts under this alternative because it maintains baseline conditions.

3.2.7 Summary

Several different measures of the economic impacts resulting from alternatives for managing PWC use in BICA are presented in this section. Each measure provides slightly different information about the expected economic effects on the region. Income and value added are generally considered the best measures of economic impacts because sales and job estimates can be misleading. Sales or output measures include spending on inputs purchased outside the region, and job estimates are distorted by part-time and seasonal positions because the data available are on jobs not on full-time equivalents. In addition, the wage rates across different jobs vary widely across industries (Stynes, 2000). Income and value-added measures both avoid these difficulties and concentrate on changes that affect only the BICA region.

NPS estimates that the total impact of the proposed alternatives for managing PWC use in BICA on regional output is $320,300, $298,870, and $0 for Alternatives A, B, and C, respectively. These increases are very small compared to the size of the regional economy, even under Alternative A.

In the analysis presented here, NPS estimates that the total impact of the proposed alternatives for managing PWC use in BICA on regional output is $320,300, $298,870, and $0 for Alternatives A, B, and C, respectively, in the first year after implementing the rule (see Table 3-6). These increases are very small compared to the size of the regional economy, even under Alternative A, which has the largest impacts. In 2000, total personal income in Bighorn (Wyoming), Carbon, and Bighorn (Montana) Counties was about $636 million (Bureau of Economic Analysis, 2002). Thus, even if all revenues related to PWC use in BICA were to reappear in the regional economy, the positive impact would be very small (regional output increases by about 0.05 percent of personal income), although businesses and communities in the county that rely heavily on PWC users may experience larger localized impacts.

3.2.8 Uncertainty

A number of factors will affect the regional economic impacts associated with the proposed alternatives. The 1996 EPA Marine Engine Rule may have an impact on PWC use nationally and in BICA. As described in Section 2.2.4, this rule requires PWC (and other SI marine engine) manufacturers to phase in emissions reductions of 75 percent between the 1998 and 2006 model years (*Federal Register*, 1996). These emissions reductions are expected to increase the cost of producing PWC over time. The corresponding increase in market price of PWC may lead to a reduction in sales that would reduce PWC ownership and use relative to the projected levels. This would tend to reduce the incremental costs and benefits attributable to NPS regulations in future years. However, production cost increases due to these regulations are probably captured in the current baseline to some degree because the rule has already required some reduction in emissions.

Although NPS has provided its best estimate of the regional economic impacts associated with the proposed alternatives, numerous sources of uncertainty may influence the results.

NPS identified the following additional uncertainties:

- The projections of PWC use through 2012 in the absence of a ban were based on NPS estimates of what annual PWC use would have been in 2003 in the absence of a ban (see Section 2.2.4 for uncertainties related to this estimate). This in turn was based on the estimates provided by BICA staff of PWC use during 2001. To the extent that PWC users accounted for an unusually small or large proportion of total visitation during this period, projected visitation by PWC users may be understated or overstated.

- The trends in local population growth may not constitute a good proxy for the future annual change in visitation to BICA by non-PWC users. It may understate or overstate the actual change in BICA non-PWC visitation that would occur in future years under baseline conditions. The uncertainties associated with the baseline projections are discussed in further detail in Section 2.2.4.
- In the absence of a ban, PWC use in the future is assumed to grow by 1 percent per year. As explained earlier, PWC registrations in Montana and Wyoming increased more sharply than 1 percent per year from 1998 to 2001, although registrations increased at a decreasing rate in both states over this period. Consequently, it is possible that future PWC use, especially in the near future, may be underestimated. However, national PWC sales have fallen very rapidly since 1995 (see Table 3-2), so it is also possible that PWC use is being overstated. If a similar trend were to continue, the number of PWC being used would start to decline. The uncertainties associated with the baseline projections are discussed in further detail in Section 2.2.4.
- The proportion of PWC users who used the park prior to the ban and will return to visit the park following implementation of new regulations is unknown. The actual proportion of users who return to visit may be higher or lower than assumed in this analysis.
- The rule proposal process itself may have affected the number of PWC users who visited BICA in 2001. If there was a reduction in PWC use in BICA because of uncertainty over future restrictions on PWC use, then the results of this analysis will not reflect this reduction. However, it is not clear that the prospect of future restrictions would have caused a reduction in visitation. In fact, it may have led to just the opposite effect as people attempted to access BICA prior to additional restrictions being implemented.
- NPS developed the scenarios used to predict impacts on local businesses based on conversations with a number of local businesses. To the extent that the expected impacts on these businesses are not representative of all affected businesses in the BICA region, the estimated impacts may be influenced upwards or downwards.
- The estimates for the share of PWC and park-related business in total revenues of potentially affected businesses were based primarily on interviews with the businesses themselves. Because NPS was unable to obtain such figures from all potentially affected firms, the average of responses was used for these shares. Values for individual firms may be either greater or less than the average used by NPS.
- In some cases, NPS used estimates of business revenues from *InfoUSA*. However, these data are only provided in ranges. NPS used the midpoint of this range for the analysis,

which may understate or overstate the actual revenue of a particular business.

- NPC identified the universe of affected entities by visiting the BICA area and contacting potentially affected businesses. In addition, NPS used secondary sources such as *infoUSA* to help identify businesses in the region that may have revenues related to PWC use in BICA. However, additional firms in the region may be directly affected by regulations on PWC use in BICA. NPS spoke directly with only a subset of the potentially affected businesses.
- Generic spending patterns and multipliers from MGM2 were used to represent economic activity in the BICA area. To the extent that spending patterns of PWC users in BICA differ from the generic spending of users and/or the generic multipliers for a national park in a small metropolitan area differ from the multipliers for the BICA region, the impacts may be understated or overstated.
- In addition, the general uncertainties and caveats are associated with the use of I-O models. These factors are described in further detail in Appendix A.

4 Benefit-Cost Analysis of the Alternative Regulations

The purpose of benefit-cost analysis is to evaluate the social welfare implications of an action—in this case the regulation of PWC use in national parks. The impacts of this action, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals.

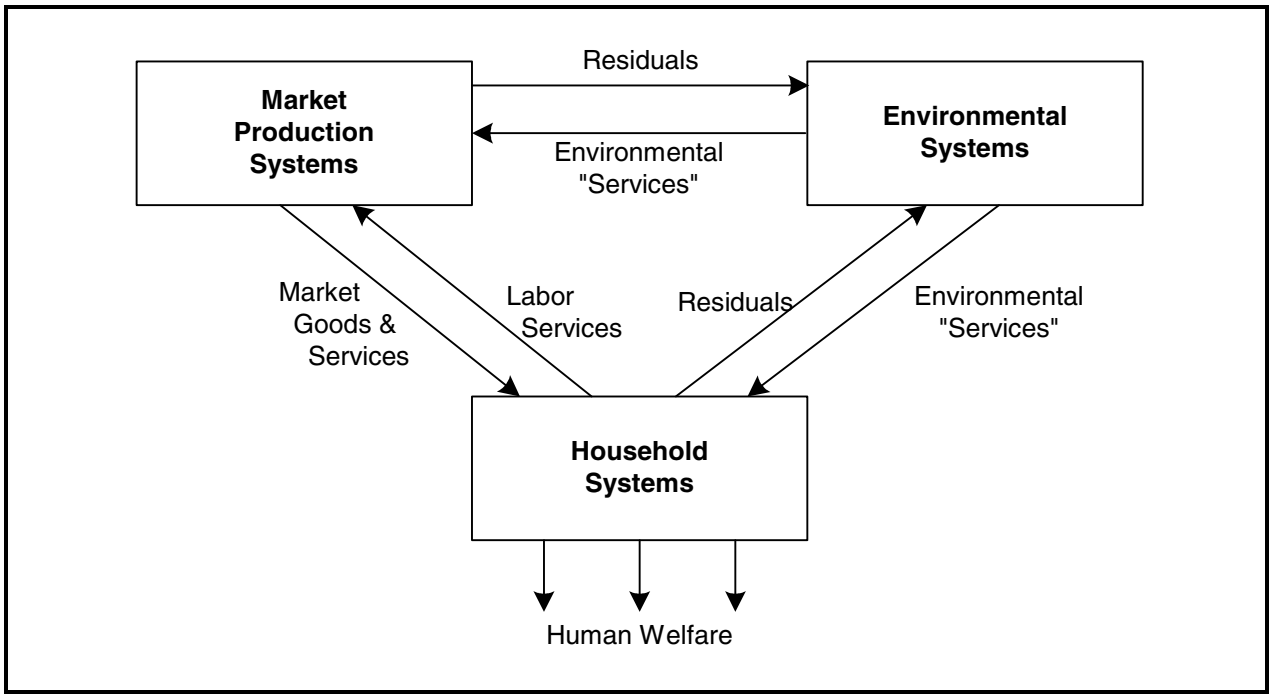
The purpose of benefit-cost analysis is to evaluate the social welfare implications of an action—in this case the management of PWC use in national parks. It examines whether the reallocation of society's resources resulting from the action promotes efficiency. That is, it assesses whether the action results in benefits (gains in social welfare) greater than the associated costs to society (losses in social welfare).

Section 4.1 provides a general outline of the approach to benefit-cost analysis and the possible benefits and costs of PWC regulations in national parks. Section 4.2 presents the analysis for BICA specifically.

4.1 CONCEPTUAL BASIS FOR BENEFIT-COST ANALYSIS OF PWC RESTRICTIONS IN NATIONAL PARKS

According to the conceptual underpinnings of benefit-cost analysis, all social welfare impacts ultimately accrue to individuals. This is represented in Figure 4-1, which depicts flows of goods, services, and residuals among three major systems: market production, household, and the environment. Because these systems are closely interconnected, actions taken to reduce releases of harmful residuals (e.g., chemicals or noise pollution) to the environment will potentially reverberate throughout all of these systems.

Figure 4-1. Interrelationship Among Market, Environmental, and Household Systems and Social Welfare



Nevertheless, the impacts of regulatory actions, both the benefits and costs, will ultimately be experienced as changes in well-being for households/individuals. As a result, identifying and measuring benefits and costs must focus on these changes in well-being.

The conceptual framework depicted in Figure 4-1 therefore provides a basis for assessing the benefits and costs of PWC regulations in national parks. In these cases, the most direct impact will be on households that use PWC, whose recreational opportunities will be affected by the regulations. This will result in direct changes in welfare for these households. In addition, the resulting changes in the behavior of these households are likely to affect environmental systems and market systems. Effects on these systems will indirectly affect the welfare of other households. For example, the park environment will be improved or degraded, and this change will change the "services" (primarily recreation-related) that the park provides to other households and individuals in society. Businesses that cater to non-PWC visitors may also be affected if the number of people visiting the park changes. On the other hand, the resulting change in the market demand for PWC-related goods and services

will have impacts for those who own or work for establishments supplying these services.

These types of direct and indirect impacts are identified and evaluated as part of this benefit-cost analysis. Specifically, in Section 4.2 NPS estimates the incremental benefits and costs relative to the baseline.

In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. In other instances, welfare changes are not directly associated with pecuniary gains or losses.

Estimating the value of benefits and costs also requires methods for expressing welfare changes in monetary terms. In certain instances, welfare changes are directly the result of monetary gains or losses and can therefore be thought of as being equivalent to these gains or losses. For example, welfare gains to PWC sales shops due to changes in demand for their services can be reasonably measured as their resulting net change in income. In other instances, welfare changes are not directly associated with pecuniary gains or losses. Such "nonmarket" changes might include, for example, the welfare gains or losses from improved or degraded recreational opportunities in a park. In these cases a surrogate measure of gains or losses must be used; willingness to pay (WTP) is such a surrogate. Economists and other practitioners of benefit-cost analysis generally accept WTP as the conceptually correct measure for valuing changes in individuals' welfare. WTP represents the maximum amount of money that an individual would be willing to forgo to acquire a specified change. As such, it is the monetary equivalent of the welfare gain from the change.

Using this conceptual framework for identifying, measuring, and valuing changes in societal welfare, the remainder of this section and Appendix B provide a more detailed discussion of

- ➤ the types of benefits and costs associated with PWC regulations in national parks and
- ➤ the approaches used in measuring these benefits and costs.

4.1.1 Social Costs of PWC Use

Use of PWC in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. The extent to which adverse impacts will be realized is a function of several factors, including the level of use, the technology of the machines being used, and the extent to which users remain in designated areas. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks'

environmental systems. The negative impacts of PWC use on other people are also referred to as negative externalities. If PWC generate negative externalities, then this represents a market failure. The private cost of using a PWC (the cost to the individual PWC user) will be lower than the social cost of PWC use (where the social cost of PWC use includes both the cost to the PWC user plus the costs to others that result from the negative externalities associated with PWC use). Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.

The private cost of using a PWC is lower than the social cost of PWC use. Because PWC users do not have to pay the full social cost of using a PWC and instead only pay the lower, private cost, PWC use will be maintained at a higher level than socially optimal in the absence of regulation.

The costs of allowing PWC in national parks can therefore be thought of and measured as the increase in these incremental losses to society. In addition, use of PWC can negatively affect society in ways that are not directly related to the environment; therefore, the incremental costs of PWC regulations allowing PWC use must also include increases in these nonenvironmental losses.

Table 4-1 provides a broad classification of the types of environmental and nonenvironmental impacts associated with PWC use in national parks. In this section, this classification is used to more completely identify, categorize, and describe the full range of potential costs associated with PWC regulations in national parks in general. In Section 4.2.3, this framework is then used to specifically describe the costs that are expected to result from the proposed management alternatives for BICA.

Table 4-1. Classification of Potential Negative Impacts from PWC Use in National Parks

Impact Categories	Examples of Impacts
Environmental impacts	
Aesthetic	Noise, visibility, odor
Human health	Through impacts to air and water quality
Ecosystems	Loss of or damage to habitat and wildlife
Nonenvironmental impacts	
Infrastructure	Costs of monitoring, maintenance, and law enforcement
Human safety	Accidents
Cultural, historical, and archeological	Physical damages

The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In areas where there are numerous areas available for recreational activities, the value of changing environmental conditions in one of those areas will tend to be smaller.

Environmental Costs of PWC Use

The use of PWC may have adverse impacts on air quality; natural resources (e.g., water quality, habitat); wildlife; and natural quiet. Figure 4-2 depicts the various categories of potential adverse effects to the environment through which PWC use in national parks can impose welfare losses on society.

- Typical (two-stroke engine) PWC release substantial amounts of noise and pollutants into the environment. Noise from PWC impairs the natural soundscape for park visitors and has the potential to negatively affect wildlife in the park. Emissions from PWC can also negatively affect park ecosystems, human health, and visitor experiences. The three primary reasons for the potential impacts due to release of pollutants are:
  - ✓ up to one-third of the fuel delivered to the engine is expelled without being burned,
  - ✓ lubricating oil is mixed with fuel and thus is expelled as part of the exhaust, and
  - ✓ the combustion process results in high emissions of air and water pollutants.

Pollutants are directly released to air and water, causing contamination of air and water resources.

As shown in Figure 4-2, all of these impacts can, directly or indirectly, lead to losses in human welfare. Therefore, from a benefit-cost perspective, those who ultimately lose from actions to allow PWC will be individuals who value the quality of the park environment. Many of those that experience losses will be park visitors whose recreational experiences are disturbed. As a point of reference, Table 4-2 reports average consumer surplus values that have been estimated for common non-PWC-related summer recreation activities from a study by Rosenberger and Loomis (2000). These are the types of recreation values that may be diminished by the presence of PWC.

The value that people place on a particular recreational activity depends strongly on the availability of substitutes. In regions where there are numerous areas available for recreational activities, the value of changing environmental conditions in one of those areas will tend to be smaller. The reason is that there are already many other areas where people can engage in the same activity. Unless there are unique characteristics that people value in the area where

Figure 4-2. Routes of Environmental Damages and Human Welfare Losses from PWC Use in National Parks

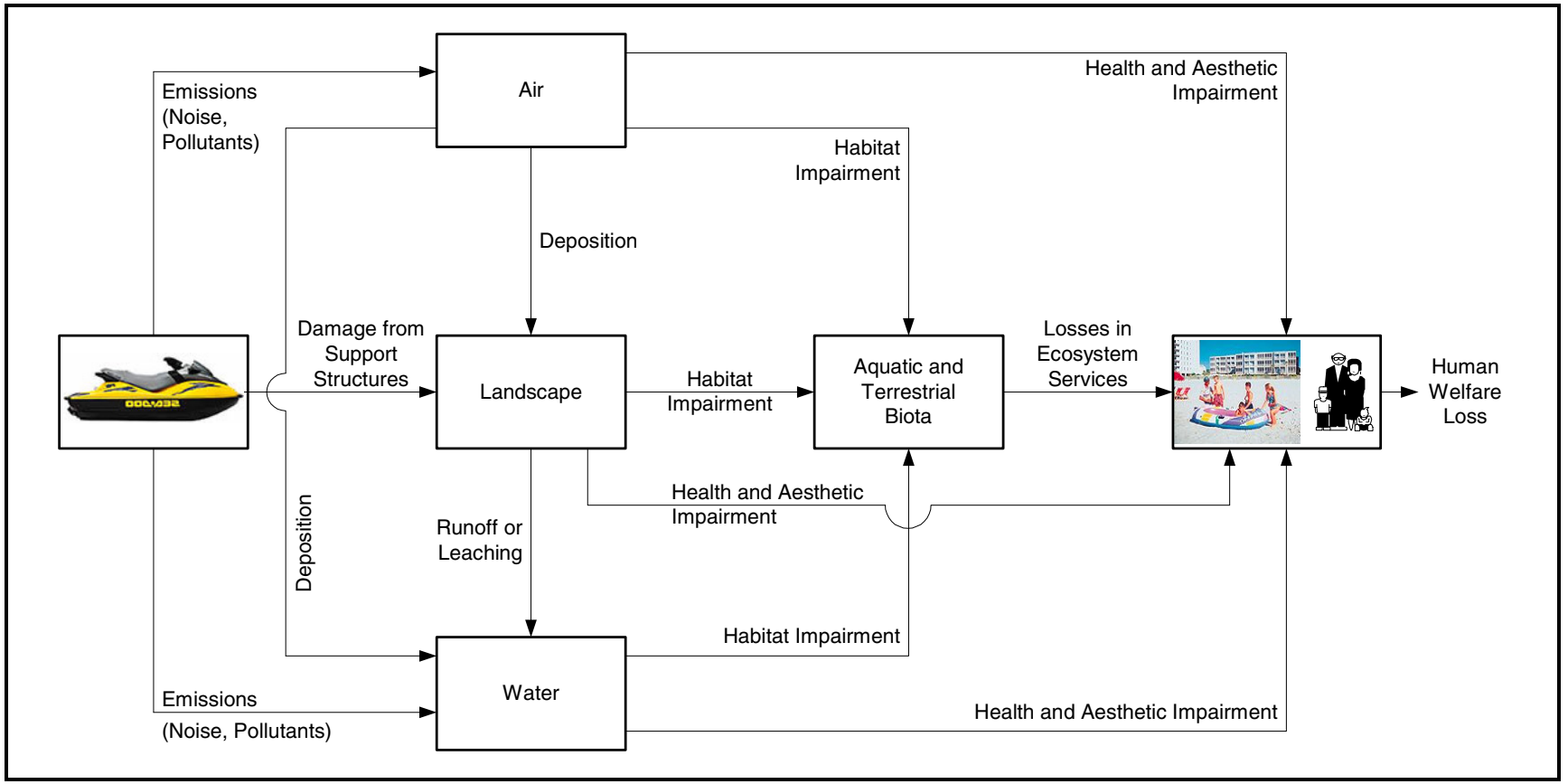


Table 4-2. Summary of Average Recreation Values (2001$ per Person per Day) for Selected Activities by Region[a,b]

Activity	Study Location					U.S. Average
	Northeast	Southeast	Mountain	Pacific	National[c]	
Picnicking	59.46 (1)	40.10 (1)	39.10 (7)	79.62 (2)	16.89 (1)	45.78 (12)
Swimming	40.06 (5)	NA	NA	16.10 (1)	22.26 (1)	34.10 (7)
Hiking/backpacking	48.46 (2)	118.40 (2)	40.29 (3)	21.95 (6)	22.47 (1)	43.48 (14)
Fishing	34.06 (42)	29.87 (13)	45.75 (39)	39.96 (16)	40.12 (4)	38.62 (114)
Motor boating	56.46 (2)	NA	74.04 (2)	16.29 (1)	41.67 (1)	53.16 (6)

NA = Not available.

[a]All amounts were inflated using the consumer price index for recreation available from the U.S. Bureau of Labor Statistics (2002). Numbers in parentheses represent the number of observations (i.e., studies).

[b]These values were taken from multiple studies conducted between 1967 and 1998.

[c]Studies estimating nationwide values.

Source: Rosenberger, Randall, and John Loomis. 2000. "Using Meta-Analysis for Benefit Transfer: In-Sample Convergent Validity Tests of an Outdoor Recreation Database." *Water Resources Research* 36(4):1097-1107.

conditions will be improved or degraded, there will probably be relatively small benefits or costs as a result of the environmental change. On the other hand, in regions with few substitutes for the local national park that would potentially experience environmental damage as a result of the regulations, the losses to park users may be much greater.

Even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. In other words, they may hold positive or negative "nonuse values" (i.e., a positive WTP) for protecting or degrading the park environment. These nonuse values can stem from the desire to ensure others' enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Pearce and Moran [1994] review studies that have attempted to estimate nonuse values for the protection of unique species and ecosystems. The measurement of nonuse value remains controversial, and in this report NPS does not attempt to quantify the possible benefits or costs associated with nonuse values. Allowing PWC use in national parks can therefore result in losses to both users and nonusers in a number of ways by degrading the parks' ecological resources.

Appendix B provides a detailed discussion of the nonenvironmental impacts in particular, and how these restrictions can affect public safety in national parks and the costs of operating and maintaining the infrastructure necessary to support and monitor PWC use.

4.1.2 Social Benefits of PWC Use

The primary benefits associated with allowing the use of PWC in national parks will accrue to

- PWC users, in particular individuals who have not been able to use PWC in a park as a direct result of restrictions on PWC use, and
- providers of PWC-related services for park visitors.

After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip.

Just as Section 4.1.1 described potential consumer surplus losses to other park visitors and the public associated with PWC use, the potential welfare gains to PWC users are measured in terms of consumer surplus. Regulations that restrict the use of PWC impose costs on PWC users. For instance, prohibiting PWC use in the park has resulted in a loss of consumer surplus for former BICA PWC users. Reinstating PWC use in BICA under restrictions such as limiting the areas of the park that are open to PWC would increase the consumer surplus of PWC users relative to baseline. A return to pre-ban PWC management practices would increase the consumer surplus of PWC users even further.

As with other activities, the extent of the welfare gain to an individual rider depends crucially on the availability of substitute areas to ride or other activities. All else equal, individuals who have fewer substitutes for PWC use (either other places to use PWC or other activities they enjoy as much) enjoy greater consumer surplus from PWC use in a particular waterbody and thus will experience a greater gain in welfare if the waterbody is opened to PWC use.

After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and other experts, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip. Table 4-2 presents the results of a review of the recreation literature conducted by Rosenberger and Loomis (2000). The review found an average value of $49.37 (1996 dollars) per person per day for riding in motor boats (with estimates ranging

from $15 to over $65). The same study reports a value of $26.79 (1996 dollars) per person per day (with estimates ranging from $20 to over $30) for off-road driving. Bhat et al. (1998) report consumer surplus estimates ranging from $9.12 to $54.93 for motorboating and waterskiing in different regions of the country. These estimates, along with the estimates in Table 4-2, provide a range of values for activities similar to riding PWC and provide a bound on the consumer surplus gain for PWC users expected from the proposed regulations. Note that measures of net consumer surplus to PWC riders that do not account for the additional costs imposed on society by the negative externalities associated with PWC use will overstate the true net social welfare associated with the activity.

Even PWC users who do not currently visit the park may have a positive value associated with maintaining access for PWC in parks that they could potentially decide to visit in the future. These users hold an option to visit the park in the future. Restrictions on PWC access to parks would reduce or eliminate the value of that option. Thus, PWC users who do not visit the park may still experience a gain in welfare if the park allows PWC use. However, because of a lack of information concerning the population of PWC users who may potentially choose to visit a given park in the future and the value that they place on that option, NPS does do not attempt to quantify the potential gains in option value.

An increase in PWC use at a particular park may also affect businesses that offer services to PWC users. These businesses are not directly affected by NPS regulations of PWC users (i.e., none of the regulations directly require any action from PWC dealerships, rental shops, or other businesses), but are likely to be impacted nonetheless. For example, allowing PWC use in national parks may lead to increased demand for PWC sales or rentals and decreased demand for motorboats or canoes. These shifts in demand may reallocate sales among businesses and may lead to an increase in total revenue for businesses providing tourism-related services. As described in Section 3, there may also be ripple effects on the local economy. If businesses that serve PWC users experience an increase in demand for their services, they will most likely increase their purchases of inputs from other sectors of the local economy, including labor. In addition, an increase in revenue for local firms tends to increase regional income. Increases in average household

income for the region surrounding the park will also lead to increases in sales for local businesses as local households respond by purchasing more goods (see Appendix A for more detailed information on ripple effects).

Whether these indirect, or secondary, impacts should be included as a change in social welfare in the benefit-cost analysis depends on whether the change in demand or supply in the secondary market results in prices changes (for details, see a benefit-cost analysis textbook such as Boardman et al. [1996]). In general, when the policy change in the primary market (PWC trips to a national park) causes prices to change in the secondary markets, the net change in social welfare from the secondary market should be included in the benefit-cost analysis. If prices do not change in the secondary market, the revenue gains or losses should not be included in the benefit-cost analysis. If the people who would have used PWC in the national park spend their money elsewhere instead, this represents a transfer from one region of the country to another or from one business to another. Although the loss in revenue may hurt the businesses located near the national park, from society's point of view this represents a transfer of income rather than a true cost to society as a whole.

Without more detailed information, it is difficult to predict with certainty whether the proposed alternatives will change prices for PWC sales or rentals. However, NPS believes the changes in demand that would occur under these alternatives may result in price changes for PWC-related markets. Thus, losses or gains to tourism-related businesses that may be indirectly affected by the alternative management strategies are included in the benefit-cost analysis.

4.2 RESULTS FOR BIGHORN CANYON NATIONAL RECREATION AREA

Based on the approach and possible impacts outlined above, this section presents the results of the benefit-cost analysis for BICA. The section discusses the groups most directly affected by the proposed alternatives for managing PWC use in the park and several scenarios for the possible levels of impacts. The benefits and costs accruing to these groups, relative to the baseline (where PWC are banned from BICA), are then presented.

4.2.1 Affected Groups

For the purpose of this study, six major affected groups, listed in Table 4-3, have been identified:

1. PWC users, in particular those who used PWC in BICA prior to the November 2002 ban and those who may wish to use PWC in BICA in the future.
2. Other visitors or potential visitors who may have a different experience at the park if PWC remain banned or are otherwise restricted in BICA (canoeists, anglers, swimmers, hikers, boaters, and other visitors).
3. Producers of PWC services in the area surrounding BICA who may experience a change in their welfare when PWC use in the park changes (e.g., PWC rental shops, PWC sales shops, restaurants, gas stations, hotels).
4. Local residents of the area surrounding BICA (not including those in any of the five other user groups).
5. Producers of services for other types of summer visitors (e.g., canoe rentals or powerboat rentals) who may experience a change in their welfare related to the number of PWC users in the park.
6. The general public who may care about the natural resources in BICA even if they do not visit the park.

The impacts on these groups under each alternative are discussed in more detail below.

Alternatives A and B, which authorize PWC use, negatively affect non-PWC park visitors and the general public. PWC users will gain consumer surplus under both of these alternatives.

Alternatives A and B negatively affect non-PWC park visitors and the general public because PWC use in BICA would be reinstated. PWC users will gain consumer surplus under both of these alternatives. Under Alternative B, PWC users who consider the location restrictions to be negative impacts may not regain the full value of their consumer surplus. NPS estimates that the regulations proposed under Alternatives A and B will increase PWC rental and sales revenues relative to baseline conditions. Local shops with PWC-related revenue will experience gains in producer surplus to the extent that these changes cause PWC users to return to BICA.

Under Alternatives A and B, NPS expects negative welfare effects for all park visitors and the general public except PWC users and the businesses that cater to them. PWC users, PWC rental and sales shops, and other businesses that provide services to PWC users are expected to experience gains of consumer and producer surplus. Adverse impacts of PWC on other users within BICA are increased

Table 4-3. Impact of Alternatives on User Groups

User Group	Alternative A	Alternative B	Alternative C (No-Action Alternative)
1. PWC users or potential PWC users	• Consumer surplus is expected to increase as a result of lifting the ban on PWC in BICA.	• Consumer surplus is expected to increase as a result of lifting the ban on PWC use in BICA, although less than under Alternative A because of location restrictions.	• No change in consumer surplus.
2. Other visitors or potential visitors: canoe users, anglers, other boaters, swimmers, hikers and other visitors	• Consumer surplus is expected to decrease for current users of BICA as a result of increased noise, decreased water quality, and an increase in the risk of accidents involving PWC. • Consumer surplus is expected to decrease for potential visitors who would have visited BICA with the ban on PWC use.	• Consumer surplus is expected to decrease slightly for current users of BICA as a result of decreased solitude, decreased water quality, and an increase in the risk of accidents involving PWC. • Consumer surplus is expected to decrease for potential visitors who would have visited BICA with the ban on PWC use.	• No change in consumer surplus.
3. Producers of PWC services: PWC rental shops, PWC sales shops, other parts of the local economy providing services to PWC users	• Producer surplus may increase for PWC rental shops. • Producer surplus may increase for PWC dealerships as a result of a rise in sales and servicing of PWC. • Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a significant increase in producer surplus.	• Producer surplus may increase for PWC rental shops. The increase would likely be smaller than under Alternative A. • Producer surplus may increase for PWC dealerships as a result of a rise in sales and servicing of PWC. The increase would likely be smaller than under Alternative A. • Other parts of the local economy such as hotels, restaurants, and gas stations are not expected to have a significant increase in producer surplus.	• No change in producer surplus.

(continued)

Table 4-3. Impact of Alternatives on User Groups (continued)

User Group	Alternative A	Alternative B	Alternative C (No-Action Alternative)
4. Local residents of the area surrounding BICA	• Local residents of nearby areas are not expected to experience a measurable change in welfare.	• Local residents of nearby areas are not expected to experience a measurable change in welfare.	• No change in welfare.
5. Producers of services for visitors to BICA who do not use PWC	• Producer surplus is expected to decrease slightly because lifting restrictions on PWC may result in a small decrease in demand for angling, canoeing, and other activities in the park, resulting in a decreased demand for the provision of services related to these activities.	• Producer surplus is expected to decrease because lifting restrictions on PWC may result in a decrease in demand for angling, canoeing, and other activities in the park, resulting in a decreased demand for the provision of services related to these activities. This decrease may be smaller than under Alternative A.	• No change in producer surplus.
6. The general public who may care about BICA even if they do not visit	• May experience a decrease in welfare as a result of degraded nonuse values resulting from decreased environmental quality in BICA.	• May experience a decrease in welfare as a result of degraded nonuse values resulting from decreased environmental quality in the recreation area. The decrease in welfare is expected to be smaller than under Alternative A because of the location restrictions for PWC use in BICA.	• No change in welfare.

under Alternatives A and B because PWC will be allowed within the park's boundaries. In addition, allowing PWC in the park would have negative impacts on other boaters' consumer surplus because of the increased probability of accidents between boaters and PWC users and increased noise levels. However, it is possible that congestion will decrease in non-NPS waters and the risk of accidents might actually decrease overall.

Alternative C, which maintains the ban on PWC use, will have no effect on any of the user groups relative to projected baseline conditions.

4.2.2 Scenarios

NPS considers current conditions, a complete ban on PWC in BICA, to be the baseline to which the alternatives are compared.

To develop estimates of the benefits and costs of the proposed rule under each alternative, NPS used the scenarios described below (see also Section 3.1). NPS considers current conditions, a complete ban on PWC in BICA, to be the baseline to which the alternatives are compared. It should be noted, that under the baseline projections, park-related PWC rentals were assumed to have declined by 100 percent relative to pre-ban levels, and PWC sales are assumed to have declined by 75 percent relative to pre-ban levels.

Alternative A

Alternative A allows PWC use in BICA according to the rules and regulations that were in effect prior to the ban in 2002. For Alternative A, it is expected that PWC users who previously used PWC in the park would return as a result of the regulation. PWC rentals, storage, and sales are assumed to return to pre-ban levels under Alternative A. It is also assumed that local convenience stores will regain 100 percent of park-related PWC revenues as a result of the reduction in visitation predicted for a ban on PWC in BICA.

Alternative B

The second alternative allows PWC use in BICA with additional location restrictions. For this alternative, NPS assumes that PWC sales and rentals will return to 95 percent of pre-ban levels.

Alternative C (No-Action Alternative)

This alternative continues the ban on the use of PWC in BICA that became effective in November 2002. Under this scenario, NPS

assumes no change in PWC rentals or PWC sales relative to the baseline.

4.2.3 Costs

As described in Section 4.1 and Appendix B, PWC use in national parks can be linked to a wide variety of negative impacts. Allowing their use in these parks can therefore result in a number of different costs to society. Section 2.5 specifically describes the impacts on natural resources that are most likely to result from PWC use within the boundaries of BICA. This section describes how these impacts will be affected by the regulatory alternatives identified above and assesses the costs of these regulations. Assessing these costs in strictly quantitative (i.e., monetary) terms is not feasible with currently available data; therefore, the costs are described in qualitative terms.

The group of visitors who would bear the largest share of the costs associated with Alternatives A and B would be BICA visitors who do not use PWC and whose park experience would be negatively affected by the use of PWC in the park.

The group of visitors who would bear the largest share of the costs associated with Alternatives A and B would be BICA visitors who do not use PWC and whose park experience would be negatively affected by the use of PWC in the park. In BICA, other popular activities include canoeing, fishing, boating, camping, swimming, and hiking. Average annual visitation to BICA was just under 1.6 million people from 1997 to 2001. Most of these visitors are believed to come to the park for some form of water-based recreation, but according to NPS estimates only about 0.651 percent of visitors were PWC users in 2001 (see Section 2.2).

"Nonusers" of the park are also likely to experience costs as a result of the proposed measures (see Section 4.1 and Appendix B for more details). For example, individuals who do not visit the parks can experience a decline in welfare simply from the knowledge that the natural resources of the park may be degraded by PWC use. Part of this loss may stem from a decreased assurance that the quality of the park's resources is being protected for the enjoyment of future generations. Therefore, some of the cost categories described below, in particular those associated with the degradation of unique

park resources and ecosystems, may accrue in the form of nonuse values.[1]

Aesthetic Costs—Noise and Visibility Impairments

Alternatives that reinstate PWC use will increase noise levels in BICA and reduce the level of natural quiet along portions of the shoreline. They also have the potential to degrade visibility by leading to an increase in the amount of ozone-causing emissions. However, because a large number of motorized boats already operate along the shore in the baseline, the incremental negative impacts of allowing PWC in the park are likely to be very small.

Alternative A: This alternative will have the greatest impact because it will allow PWC in all areas in BICA. However, as described above, noise from other boating activities already infiltrates BICA. Because of the small percentage of PWC use compared to other watercraft, changes to soundscape quality are expected to be slight, and this alternative is not expected to result in an impairment of soundscape values (NPS, 2003). It is expected that with improved technology, quieter PWC will become the standard, and sounds generated by PWC will decrease over time.

Alternative B: Negligible to moderate detrimental impacts in soundscape quality relative to baseline are anticipated under this alternative (NPS, 2003). Under Alternative B, PWC will continue to be prohibited from accessing waters south of the South Narrows of BICA. These areas may not experience a noticeable change in noise as a result of lifting the ban on PWC in other areas.

Alternative C (No-Action Alternative): This alternative continues current policy and offers no change in soundscape relative to current conditions.

Allowing PWC under Alternatives A and B will result in additional aesthetic costs to recreators in the parks, such as canoeists, anglers,

[1] The importance of recognizing these values is affirmed in the Organic Act. It established the fundamental purpose of the national park system, which includes providing for the enjoyment of park resources and values by the people of the United States. The mandate applies not just to the people who visit parks—but to all people—including those who derive inspiration and knowledge from afar. Furthermore, through the Redwood Act of March 27, 1978, Congress has provided that when there is a conflict between conserving national park resources and values and providing for enjoyment of them, conservation is to be the primary concern.

birdwatchers, and hikers, relative to baseline conditions. Noise emissions have been identified as a particular nuisance to nonmotorized recreators, such as canoeists and hikers, who tend to place a particularly high value on the tranquility and natural soundscape offered by the parks. Anglers using motorized boats also value the natural soundscape, and while fishing, often operate their boats with quiet electric motors to avoid disturbing fish. Therefore, increasing noise from PWC activity in the parks would degrade the experience of both motorized and nonmotorized recreators.

In addition to generating high noise levels, PWC also emit strong-smelling fumes that can be bothersome to other recreators and reduce visibility. These effects tend to be much more localized than noise emissions. Finally, NPS assumes that visibility impacts from PWC emission increases from allowing PWC under Alternatives A and B will be negligible.

Human Health Costs

PWC emissions contain relatively high levels of pollutants such as VOC, CO, PM, NO_x, and HCs, which are potentially damaging to human health. It is very unlikely that the level of PWC use in BICA prior to the ban in 2002 represented a significant health threat to humans; nevertheless, the potential for adverse health effects exists. For example, some of the toxic HCs are potentially harmful even at very low levels of exposure (EPA, 2000a; EPA, 1999a). The relatively large number of other motorized watercraft that operate in BICA means that allowing PWC would result in only a small increase in emission levels. In summary, the health costs from the proposed regulations are expected to be negligible for all of the alternatives (NPS, 2003).

Ecosystem Degradation Costs

As discussed in Sections 2 and 4.1 of this report, PWC use has the potential to negatively affect ecosystems and natural habitats in a variety of ways. In the case of national parks, these natural resources are of particular value to the public. Although levels of PWC use prior to the ban in BICA are not expected to have caused widespread ecosystem damages, allowing PWC in the parks can nonetheless result in costs to visitors and nonusers by potentially degrading some of the parks' natural resources.

Alternative A: This alternative may have some negative impact on water quality. However, in general, allowing PWC in BICA as proposed under Alternative A is not expected to result in exceedances of human or eco-toxicological water quality benchmarks. Noise has the greatest potential to disturb wildlife in BICA. Localized, short-term effects on wildlife may occur as a result of reinstating PWC use in BICA. The PWC-specific incremental effect would be small because of the presence of other motorized watercraft.

Alternative B: This alternative would have similar impacts on water quality as Alternative A, although the location restrictions under this alternative may result in reduced impacts to the areas south of the South Narrows. These areas would not experience as great of an increase in noise or emissions as other areas of the park. Overall, the PWC-specific effect of Alternative B would be small because of the presence of other motorized watercraft.

Alternative C (No-Action Alternative): This alternative offers no costs to society for ecosystem degradation compared to the current situation.

As discussed in Section 2.5, fish and wildlife may be adversely affected by the use of PWC in the park. In addition to being a potential nuisance to other recreators, noise from PWC may disturb wildlife. Localized, short-term but negligible to minor effects on wildlife may occur under Alternatives A and B by increasing noise disturbance and the chance for collisions with wildlife. Although no water quality impacts associated with PWC use in BICA have been documented, there may be a long-term negative impact to aquatic biota and the ecosystems in the park because of minor degradations in water quality and an increase in physical disturbances.

Introducing potential harm to the park's ecosystems will result in welfare losses for park visitors, for example, by decreasing their chances of viewing wildlife in a less stressful environment. It will also result in welfare losses to individuals across the country who value the park's unique ecosystems and natural habitats, regardless of whether they actually visit the park. That is, degrading the park's ecosystems can result in nonuse costs to society.

Safety and Congestion Costs

In addition to environmental costs associated with increases in PWC use, there may also be safety and congestion costs. Since 1990, injuries associated with the recreational use of PWC have increased at least four-fold. The number of injuries reported from PWC use is now higher than that reported from motorboat use in the U.S. (Branche, Conn, and Annest, 1997). Because of the disproportionately large number of injuries associated with PWC use, allowing their use may decrease the safety of park visitors. In addition, the level of congestion is an important factor determining visitor enjoyment. Increases in congestion related to PWC use may therefore have costs to other park users.

Alternative A: Alternative A allows PWC in the park, and it may harm all recreators by increasing their risks of being involved in accidents with PWC.

Alternative B: Potential costs resulting from Alternative B include those discussed for Alternative A, but they may be less severe as a result of location restrictions.

Alternative C (No-Action Alternative): This alternative offers no costs to society related to safety and congestion compared to the current situation.

Any increase in accidents that may result from the return of PWC to BICA will increase the costs to NPS associated with medical/rescue operations, which may require resources to be redirected from other park management activities. However, these costs are not likely to be large in BICA.

4.2.4 Benefits

For visitors who used PWC in BICA prior to the ban or who want to ride in the park in the future, allowing PWC use in the park could result in consumer surplus gains.

PWC users, as well as some businesses in the local area, may experience welfare gains as a result of management alternatives that permit PWC use in the park.

Benefits to PWC Users

Two main groups of PWC users may be affected by the proposed regulations: those who used PWC in BICA prior to the ban and those who use PWC in substitute areas outside BICA where PWC users displaced from BICA may have increased their use since PWC use in BICA was banned.

PWC users who currently ride in nearby areas where displaced riders from BICA may have visited will gain some consumer surplus if these areas become less crowded because of lifting restrictions on PWC use in BICA. Although no studies were available that examined the impact of congestion on the value of a PWC trip, other recreation demand studies find that congestion lowers the value of a recreation experience (see Appendix B). For PWC users who rode in BICA prior to the ban or who want to ride in the park in the future, allowing PWC use in the park could result in consumer surplus gains. To the extent that individuals consider other PWC areas close substitutes, the change in consumer surplus associated with allowing PWC use in the park will be lower. In the case of BICA, several nearby substitute areas have less stringent regulations (see Section 2.3).

If each individual's demand curve for riding a PWC in BICA were known, then NPS could add up the gain of consumer surplus for each individual to find the total change in consumer surplus to PWC riders from the proposed regulations. Because the demand curve reflects the individual's preferences for available substitute activities and the cost of these activities, measuring the change in consumer surplus from a trip in the park takes into account substitute activities. In this case, NPS does not know the consumer surplus associated with PWC use in BICA, nor does NPS know the riders' next best alternative activities.

To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique.

To assess the incremental change in consumer surplus for PWC users, NPS used the benefit transfer technique. After conducting an extensive review of the economics literature and consulting with the authors of existing studies, experts in recreation demand analysis at universities, and experts at other consulting firms, NPS was unable to locate a study that estimated the consumer surplus for a PWC trip. A review of the recreation literature conducted by Rosenberger and Loomis (2000) found an average value of $31.98 (1996 dollars) per person, per day for riding in motorboats in the entire United States (with estimates ranging from $15 to over $50). Bhat et al. (1998) estimate an average consumer surplus of $45.61 (1998 dollars) associated with motorboating and waterskiing in an area that includes parts the Rocky Mountain region of Montana and Wyoming (along with the Rocky Mountain regions of Colorado and New Mexico). Converted to 2001 dollars, the average consumer

surplus reported in this study is $49.56. The estimate comes from a travel cost model based on data from the Public Area Recreation Visitors Study (PARVS). The PARVS data were a multiagency survey that included on-site interviews of recreationists at over 350 sites across the U.S. between 1985 and 1992. For the benefit transfer, NPS used the value from Bhat et al. (1998) based on the following criteria:

- Waterskiing and motorboating are similar activities to PWC use.
- The region where the data were collected includes Montana and Wyoming, where the study site is located.
- Bhat et al. (1998) was published in a peer-reviewed journal. The authors estimate a travel cost model using data from on-site interviews and only estimate values for activities in a particular region for which at least 100 observations were collected.

Below NPS discusses the estimated impact of each proposed alternative on PWC users.

Alternative A: This alternative would result in allowing PWC use in BICA. Those visitors using PWC in BICA prior to the ban would regain the full value of their consumer surplus for rides in BICA.

Using the value of $49.56 for a day of PWC use, NPS provides estimates of possible incremental gains in consumer surplus to PWC users as a result of Alternatives A and B.

Alternative B: This alternative would result in allowing PWC use only in certain areas of BICA. Those riders who used PWC in BICA prior to the ban and would return to BICA under Alternative B would regain the full value of their consumer surplus for rides in BICA. Those visitors who used PWC in BICA prior to the ban but would not return to use PWC because of the location restrictions in place would not experience gains in consumer surplus due to the change in BICA PWC regulations.

Alternative C (No-Action Alternative): Under Alternative C, NPS anticipates no change in PWC use as a result of the regulation. Consumer surplus to PWC users will remain unchanged from current conditions.

Using the value of $49.56 for a day of PWC use, NPS provides estimates of possible incremental gains in consumer surplus to PWC users as a result of Alternatives A and B. NPS assumes that visitors who return to use PWC in BICA will gain the full value of consumer surplus associated with a day of PWC use. Table 4-4 summarizes the projected consumer surplus gains for PWC users in BICA for

Table 4-4. Projected Incremental Change in Consumer Surplus for PWC Users Under Alternatives A and B, 2003–2012 (2001$)[a]

	Alternative A		Alternative B	
Year	Change in Number of People Using PWC	Change in Consumer Surplus ($)	Change in Number of People Using PWC	Change in Consumer Surplus ($)
2003	1,572	$77,910	1,493	$74,020
2004	1,588	$78,690	1,508	$74,760
2005	1,604	$79,480	1,523	$75,500
2006	1,620	$80,270	1,539	$76,260
2007	1,636	$81,080	1,554	$77,020
2008	1,652	$81,890	1,570	$77,790
2009	1,669	$82,710	1,585	$78,570
2010	1,685	$83,530	1,601	$79,360
2011	1,702	$84,370	1,617	$80,150
2012	1,719	$85,210	1,633	$80,950
PV (3%)[b]	NA	$693,650	NA	$658,960
PV (7%)[c]	NA	$569,370	NA	$540,900

[a]All impacts were rounded to the nearest $10.

[b]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rat in the valuation of lost natural resources use (61 FR 453; 61 FR 20584).

[c]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

Alternatives A and B from 2003 to 2012 and the present value (PV) of these losses using both 3 percent and 7 percent discount rates. The PV is the value of a future stream of benefits or costs, discounted to current years. Under Alternative C, there will be no change in PWC use relative to baseline conditions and therefore no change in consumer surplus derived by PWC users.

Uncertainty: The estimates of consumer surplus gains to PWC users are uncertain for a variety of reasons. Some of the main sources of uncertainty are as follows:

- The estimate of the number of PWC users who used BICA prior to the ban is uncertain, as are the projections of future PWC use under Alternatives A and B.
- The actual consumer surplus associated with PWC use in BICA may be different from the value used in the analysis. The value used in the analysis is based on studies of riding in motorboats and waterskiing. In addition, the value is based on a full day of motorized water-based recreation. To

the extent that PWC users use PWC for only a small fraction of the day, spending the rest of the day engaged in more traditional beach activities, consumer surplus for PWC users may be closer to non-PWC users' surplus value (estimated in Section 4.2.3) than to other motorized watercraft users' surplus.

- ➤ The values in Table 4-4 may overstate true gains under Alternative B because of assumptions about the consumer surplus of PWC users who return to ride in the park. In the analysis of Alternative B, PWC users who return to use PWC in BICA may be inconvenienced by location restrictions. These requirements may decrease the consumer surplus associated with using a PWC in BICA even for those riders who use PWC in the park.
- ➤ The 1996 EPA Marine Engine Rule may result in lower PWC use in the future if the cost of new machines increases. If fewer riders would visit the park, the incremental consumer surplus gains associated with Alternatives A and B would be lower.

Benefits to the Local Area Businesses

If PWC use increases as a result of the regulation, then the suppliers of PWC rental, sales, and service will be directly affected. In addition, lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders could experience an increase in business from the proposed regulation. Section 5 describes these impacts in more detail.

PWC Sales and Rental Services. NPS identified three firms that own and operate one or more PWC sales, service, or rental shops near BICA. Three of these firms sell new or used PWC (these shops generally also provide PWC service) and one provides PWC rentals. As described in Section 3.1, NPS estimated the changes in visitation and local business revenues that would result from each of these alternatives.

Lodging Establishments, Restaurants, Gas Stations, and Other Businesses. Purchases made by PWC users contribute to total economic activity in the area surrounding BICA. It is possible that positive localized impacts on tourism-related businesses located near BICA will occur if changes in PWC management result in changes in visitation to the recreation area. The proposed restrictions could affect lodging establishments, restaurants, gas stations, and retail stores in the area. These establishments may be affected if the proposed restrictions lead to changes in visitation to the park and

surrounding area. However, PWC users comprise a small fraction (approximately 0.65 percent) of total visitation to BICA. Therefore, lodging establishments, restaurants, gas stations, and other businesses that serve PWC riders are not likely to experience a significant change in business under any of the alternatives.

Based on the existing data and interviews with local businesses, NPS expects Alternatives A and B will result in increases in PWC revenue associated with BICA. The expected increases are described in Section 3.1. Based on the scenarios outlined in Section 3.1 for each of the alternatives, NPS calculated revenue increases (see Table 3-6).

To translate increased revenue into changes in producer surplus for purposes of benefit-cost analysis, NPS used estimates of the increase in revenue associated with the rule and return-on-sales measure for the Standard Industrial Classification (SIC) code provided by Dun & Bradstreet (D&B). The use of this profit margin only approximates gains in producer surplus. Producer surplus captures the difference between variable costs and revenue, while return on sales contains other measures reflecting fixed costs, taxes, and/or accounting conventions rather than measures of variable profits. For this reason, the use of D&B accounting profit margin data may understate producer surplus gains.

The profit ratios, net profit after tax divided by sales, come from D&B (2001).[2] For instance, the upper quartile profit ratio for sales shops is 4.6 percent and the lowest quartile is 0.6 percent. For rental shops, the upper quartile profit ratio is 8.7 percent and the lowest quartile is –3.4 percent. However, none of the rental shops that NPS interviewed indicated that they had a negative profit margin. Therefore, NPS used the median profit ratio (3.9 percent) in this analysis. Estimated profit ratios for each of the industries expected to be directly affected by PWC restrictions in BICA are provided in Table 4-5.

[2]D&B data for North American Industry Classification System (NAICS) codes are not currently available. Therefore, NPS used the comparable SIC code 5571 (Motorcycle Dealers) as defined by the U.S. Census (i.e., SIC 5571, Motorcycle Dealers) for PWC dealerships. For rental shops, NPS used SIC code 7999 (Amusement and Recreation NEC).

Table 4-5. Profit Ratios Used for Calculating Changes in Producer Surplus

	Profit Ratios		
	SIC	Bottom Quartile	Upper Quartile
PWC rentals	7999	3.9%	8.7%
PWC sales	5571	0.6%	4.6%
Restaurants and bars	5812	0.6%	7.5%
Grocery stores	5411	0.4%	3.0%
Gas and oil	5541	0.1%	3.1%
Souvenir shops and other retail establishments	5947	1.1%	9.9%

For businesses in the BICA region, estimated producer surplus gains associated with imposing the regulatory alternatives relative to the baseline are presented in Table 4-6.[3] There are no producer surplus gains expected under Alternative C, the no-action alternative. The majority of the estimated producer surplus gains occur in the PWC sales/service and rental and other retail markets under Alternatives A and B. For Alternative A, estimated producer surplus gains are between $2,660 and $20,400 for PWC sales/service and $1,590 to $3,550 for PWC rentals. Under Alternative B, producer surplus gains are estimated to range from $2,480 to $19,040 for PWC sales/service and from $1,510 to $3,370 for PWC rentals. The range of gains predicted for the other business categories, which include restaurants and bars, groceries/take-out, gasoline and oil, and souvenir/retail shops is between $0 and $170 depending on the business category, the alternative, and the profit ratio used. Overall, producer surplus gains are estimated to be between $4,290 and $24,370 under Alternative A and between $4,020 and $22,730 under Alternative B.

Table 4-7 summarizes the estimated change in producer surplus for the period from 2003 to 2012. The PV of estimated incremental increases in producer surplus for Alternative A ranges from $36,980 to $210,640 using a 3 percent discount rate and from $29,230 to $166,440 using a 7 percent discount rate. For Alternative B, the PV

[3]Estimated producer surplus gains in future years have a similar distribution across industries.

Table 4-6. Changes in Producer Surplus in the First Year Resulting from PWC Use Management Alternatives in BICA (2001$)[a]

	Alternative A		Alternative B		Alternative C	
	Low	High	Low	High	Low	High
PWC rentals	$1,590	$3,550	$1,510	$3,370	$0	$0
PWC sales/service	$2,660	$20,400	$2,480	$19,040	$0	$0
Lodging	$10	$90	$10	$70	$0	$0
Restaurants and bars	$10	$120	$10	$90	$0	$0
Groceries/take-out	$0	$20	$0	$20	$0	$0
Gas and oil	$0	$20	$0	$10	$0	$0
Souvenirs and other retail	$20	$170	$10	$130	$0	$0
Total	**$4,290**	**$24,370**	**$4,020**	**$22,730**	**$0**	**$0**

[a]All impacts were rounded to the nearest $10. Columns may not sum to totals due to rounding.

of producer surplus increases is estimated to be between $34,700 and $196,470 using a 3 percent discount rate and between $27,420 and $155,240 using a 7 percent discount rate. Alternative C, the no-action alternative, continues baseline management of PWC and will not result in changes in producer surplus.

Uncertainty

A number of factors will affect local business revenues and the resulting estimates of changes in producer surplus associated with the proposed alternatives. Important factors include the uncertainty surrounding the baseline projections as described in Section 2.2, uncertainty concerning the estimation of output reductions as described in Section 3.3.8, and the use of national average accounting profit ratios to approximate producer surplus gains to individual local businesses.

NPS Enforcement Costs

In addition to costs incurred by PWC users and local businesses under regulation, costs may be incurred by taxpayers to support an increase in enforcement efforts by park staff. Although it is possible that additional staff may be required under Alternatives A and B relative to the baseline, the number of staff (if any) that would be hired is uncertain.

Table 4-7. Changes in Producer Surplus Resulting from PWC Use Management Alternatives in BICA, 2003–2012 (2001$)[a]

	Alternative A		Alternative B		Alternative C	
Year	Low	High	Low	High	Low	High
2003	$4,290	$24,370	$4,020	$22,730	$0	$0
2004	$4,330	$24,610	$4,060	$22,960	$0	$0
2005	$4,370	$24,860	$4,100	$23,190	$0	$0
2006	$4,410	$25,110	$4,140	$23,420	$0	$0
2007	$4,450	$25,360	$4,180	$23,650	$0	$0
2008	$4,490	$25,610	$4,220	$23,890	$0	$0
2009	$4,530	$25,870	$4,260	$24,130	$0	$0
2010	$4,580	$26,130	$4,300	$24,370	$0	$0
2011	$4,630	$26,390	$4,340	$24,610	$0	$0
2012	$4,680	$26,650	$4,380	$24,860	$0	$0
PV (3%)[b]	**$36,980**	**$210,640**	**$34,700**	**$196,470**	**$0**	**$0**
PV (7%)[c]	**$29,230**	**$166,440**	**$27,420**	**$155,240**	**$0**	**$0**

[a]All impacts were rounded to the nearest $10.

[b]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

[c]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

Prior to November 2002, law enforcement activities associated with PWC use at BICA were incidental to other park services. As described in Section 2.2.2, NPS staff estimate that prior to the ban, PWC made up less than 5 percent of watercraft in BICA. BICA staff indicated that the costs of enforcing PWC regulations are considered incidental to enforcement of general boating regulations, because no funding or personnel are dedicated exclusively to enforcement of PWC regulations at BICA. As described in Section 2.1, at BICA, there are three full-time protection rangers and three seasonal protection rangers whose job is to enforce all regulations throughout the recreation area. During periods of heavy watercraft use, such as weekends and holidays, one or two rangers may be on Bighorn Lake patrolling for 1 to 3 hours per day enforcing state boating regulations. State enforcement presence on Bighorn Lake in

both Montana and Wyoming is limited to sporadic visits. Prior to the ban, the number of reported violations or accidents involving PWC was low. The most common citations were for underage riding, wake jumping, violation of no-wake restrictions at marinas, and failure to wear floatation devices. There was one recorded accident involving a PWC in 2000 and one accident in 2001. There were also anecdotal reports of conflicts between PWC users and anglers prior to the ban.

Although in the past, the enforcement of PWC regulations has been incidental to other park enforcement activities, without additional data NPS cannot be certain that allowing PWC under Alternatives A and B will not necessitate additional enforcement staff in the future. Consequently, NPS does not quantify enforcement costs associated with implementing Alternatives A and B. Alternative C, which continues baseline conditions, will not result in any additional enforcement costs for BICA.

4.3 SUMMARY

Alternative C, the no action alternative, maintains the baseline in this analysis. Under that alternative, all PWC use would remain prohibited from the park. Alternative A would permit PWC use as managed in the park prior to the ban, and Alternative B would permit PWC use but with location restrictions compared with pre-ban management. The benefits of any alternative are measured relative to the baseline conditions, which are represented by Alternative C. Therefore, there are no incremental benefits associated with Alternative C. The primary beneficiaries of Alternatives A and B would be the park visitors who use PWC and the businesses that provide services to PWC users such as rental shops, restaurants, gas stations, and hotels. Additional beneficiaries include individuals who use PWC outside the park where PWC users displaced from the park may decide to ride if PWC use within the park were prohibited. Benefits accruing to individual PWC users are called consumer surplus gains, and those accruing to businesses are called producer surplus gains. Consumer surplus measures the net economic benefit obtained by individuals from participating in their chosen activities, while producer surplus measures the net economic benefit obtained by businesses from providing services to individuals. These benefits, projected over a 10-year horizon, are summarized in Table 4-8.

Table 4-8. Present Value of Projected Incremental Benefits Under Alternatives A and B, 2003–2012

	PWC Users	Businesses	Total
Alternative A			
Discounted at 3%[a]	$693,650	$36,980 – $210,640	$730,630 – $904,290
Discounted at 7%[b]	$569,370	$29,230 – $166,440	$598,600 – $735,810
Alternative B			
Discounted at 3%[a]	$658,960	$34,700 – $196,470	$693,660 – $855,430
Discounted at 7%[b]	$540,900	$27,420 – $155,240	$568,320 – $696,140

[a]The economics literature supports a 3 percent discount rate in the valuation of public goods (e.g., Freeman, 1993). Federal rule-makings also support a 3 percent discount rate in the valuation of lost natural resources use (61 FR 453; 61 FR 20584). While the welfare impacts in this case are private goods, the 3 percent discount rate was used to be consistent with discounting of other impacts in this report.

[b]Office of Management and Budget (OMB). 2002. "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs: Memorandum for Heads of Executive Departments and Establishments." OMB Circular A-94, revised January 22, 2002.

As with the benefits described above, the costs of any alternative are measured relative to the baseline conditions, which are represented by Alternative C. Therefore, there are no incremental costs associated with Alternative C. The primary group that would incur costs under Alternatives A and B are the park visitors who do not use PWC and whose park experiences would be negatively affected by PWC use within the park. Non-PWC uses at BICA include boating, canoeing, fishing, and hiking. However, these costs could not be quantified because of a lack of available data. Additionally, the public could incur costs associated with impacts from Alternatives A and B to aesthetics, ecosystem protection, human health and safety, congestion, nonuse values, and enforcement. However, these costs could not be quantified because of a lack of available data.

Because the costs of the alternatives are not quantified, the benefits presented in Table 4-8 represent the quantified net benefits of Alternatives A and B. As noted above, because of a lack of available data, these net benefits do not account for the costs of enforcement; the costs to non-PWC users; or those costs relating to aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values. Therefore, these net benefit estimates

do not reflect all costs. If all costs could be incorporated, the indicated net benefits for each alternative would be lower.

From an economic perspective, the selection of Alternative B as the preferred alternative is considered reasonable because certain costs could not be quantified in the net benefits presented above. Those costs, relating to non-PWC use, aesthetics, ecosystem protection, human health and safety, congestion, or nonuse values, would likely be greater for Alternative A than for Alternative B. Given that the quantified net benefits of Alternatives A and B are similar, further inclusion of these unquantified costs could reasonably result in Alternative B having the greatest level of net benefits. Therefore, based on these factors, Alternative B is considered to provide the greatest level of net benefits.

5 Small Entity Impact Analysis

Alternatives A and B are expected to have positive effects on small businesses relative to baseline conditions, while Alternative C has no incremental impacts.

Changes to the management of PWC use in national parks potentially affect the economic welfare of a number of businesses, large and small. However, small entities may have special problems in complying with such regulations. The Regulatory Flexibility Act (RFA) of 1980, as amended in 1996, requires special consideration be given to these entities during the regulatory process.

To fulfill these requirements, agencies must perform a review to determine whether a proposed or final rule will have a significant economic impact on a substantial number of small entities. This section assesses the potential for PWC regulations in BICA to affect small businesses. Expected changes in revenues across firms and regional economic impacts are discussed in Section 3, and expected changes in producer surplus are discussed in Section 4.

5.1 IDENTIFYING SMALL ENTITIES

As described in Sections 2 and 3, NPS attempted to identify the firms in the region surrounding BICA that would experience the most significant impacts as a result of PWC regulations in BICA. The relatively small expected changes in total visitation to the BICA area as a result of implementing any of the proposed alternatives suggest that there will be no noticeable regional impacts on lodging establishments and restaurants. It is possible that these tourism-related industries may experience localized impacts in communities located adjacent to BICA, but any impacts are expected to be small

relative to the impacts estimated for businesses that provide PWC sales, rentals, and service.

In addition, there are wide variations in recreational visitation to BICA from year to year. This variation in visitation likely causes similar year-to-year variations in revenue for local firms that rely on tourism. The fact that firms remain in business despite these low visitation/low revenue years provides some anecdotal evidence that small firms are able to remain in business even if they experience a change in revenue. The businesses most likely to be directly affected by PWC regulations are those offering PWC rental, sales, and/or services. NPS identified one PWC rental and sales shop and two PWC sales and/or service firms in, Billings, Montana, which is within 75 miles of BICA. The impacts on the PWC-related businesses considered here are believed to be representative of the upper bound of impacts that would be experienced by local businesses under Alternative A or B. Under Alternative C, the no-action alternative, no incremental impacts are expected for small businesses because it maintains baseline management conditions under which PWC were banned from BICA in November 2002.

NPS classified two of the three identified affected firms as small for this analysis.

The SBA's general size standard definitions for NAICS 532292 (Recreational Goods Rental[1]) and NAICS 441221 (Motorcycle Dealers[2]) classify companies with annual sales less than or equal to $5 million as small (SBA, 2002). NPS computed total revenue for each firm in one of the following ways:

- Interview data—For two of the three PWC sales, service, and rental shops, NPS used interview data on total revenue, the share of that revenue made up by PWC-related business, and the share of PWC revenue that is related to PWC use in BICA to obtain PWC revenue estimates, total revenue estimates, and park-related PWC revenue estimates.
- *infoUSA (2002)* data—For the remaining firm, NPS used the midpoint of the sales range reported for the firm by *infoUSA (2002)*.

[1]This industry comprises establishments primarily engaged in renting recreational goods, such as bicycles, canoes, motorcycles, skis, sailboats, beach chairs, and beach umbrellas.

[2]This industry comprises establishments primarily engaged in retailing new and/or used motorcycles, motor scooters, motor bikes, mopeds, off-road all-terrain vehicles, and PWC or retailing these new vehicles in combination with repair services and selling replacement parts and accessories.

Based on this approach, NPS estimated these three firms had a total of $14 million in annual revenue in 2000. Two of these companies are estimated to have annual sales between $1.0 million and $5.0 million (67 percent), and one is estimated to have above $5.0 million (33 percent). After additional review and data collection, NPS determined one of the three firms is a large company with sales exceeding $5 million. Therefore, NPS classified two of the three identified affected firms as small for this analysis.

5.2 ASSESSMENT

After considering the economic impacts of the PWC regulations in BICA on small entities, NPS concludes that none of the management alternatives will have a significant negative impact on a substantial number of small businesses. Alternatives A and B will have a positive impact on small businesses relative to the baseline scenario, under which PWC were banned from BICA in November 2002. The no-action alternative (Alternative C) will not have a significant negative impact on a substantial number of small entities because it will not result in a change from baseline conditions. NPS made the determination that these management alternatives would not have a significant negative impact on small entities using RFA implementation guidance provided by other agencies (NMFS, 2000; EPA, 1999b; SBA, 2003) and provides the following factual basis for this determination:

Do the proposed regulations have a significant negative impact on a substantial number of small entities?

Alternative A: No

Alternative B: No

Alternative C: No

- This rule is not expected to reduce any of the area businesses' profit margins or reduce the competitiveness of the PWC rental and retail businesses.
- NPS projects increases in revenue relative to the baseline for firms selling and renting PWC to BICA visitors and for other firms that cater to large numbers of PWC users under Alternatives A and B.
- NPS projects higher overall levels of revenue for other businesses (restaurants, grocery stores, gas stations, and souvenir shops) in the BICA region relative to the baseline under Alternatives A and B.
- NPS projects no change in revenue for local small businesses relative to baseline conditions under Alternative C, the no-action alternative.

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Appendix A: Economic Impact Analysis

Expenditures made by visitors to national parks have a variety of economic impacts on the region where the park is located. For instance, tourists contribute to sales, profits, jobs, tax revenues, and income in a region. The most direct effects are felt within the primary tourism sectors: lodging, dining, transportation, entertainment, and retail trade. However, when indirect effects are included, almost all sectors of the economy are affected by tourism. This occurs because spending by tourists on the primary tourist sectors leads those sectors to purchase inputs into their production process from other industries, which then purchase more inputs themselves and so on. In addition, as local household income rises because of the impact of tourism, these households purchase more goods and services from many different industries. This leads to higher incomes for households deriving income from these other industries, which causes them to purchase more goods and services as well. These feedback effects continue indefinitely, but become smaller and smaller in each round as a result of leakage because not all income is spent within the regional economy. These effects on household spending are known as induced effects.

A simple example from Stynes (2000) illustrates this point. Assume a region attracts an additional 100 tourists, each spending $100 per day. The direct impact of this increase in tourism is $10,000 per day in new spending. If sustained over a season of 100 days, the region would experience an increase in sales of $1 million. This spending would primarily take place in the lodging, dining, entertainment, and retail sectors in proportion to how each visitor spends his/her $100. Not all of the value of this spending can be

assumed to accrue within this region because the cost of goods made in other regions should not be included as a direct sales effect in the local area. For example, gasoline purchased by tourists for $1.50 per gallon should not be included as a local spending impact of $1.50 per gallon. Instead, only the retail margin on the gasoline can be considered a direct effect of tourism spending. The margins on gasoline are relatively small. Assuming a retail margin of 12 percent suggests that the direct impact of spending on gasoline to the local area is only about 18 cents per gallon. Wholesale margins are also included for wholesalers located within the region of interest.

Returning to the example above, perhaps 30 percent of the million dollars in direct spending would leak out of the area to cover the costs of goods purchased by tourists that were produced outside the region. The remaining $700,000 increase in direct sales might yield $350,000 in income within tourism-related industries and support 20 jobs directly linked to tourism. Tourism industries tend to be labor intensive, translating a relatively high proportion of sales into income and jobs.

The tourism industry buys goods and services from other industries located in the area to provide the goods and services offered to tourists. For example, changes in sales, jobs, and income in the linen industry (an industry supplying products to hotels) will result from changes in hotel sales. Also, as mentioned above, this industry is typically very labor intensive. Therefore, most of the $350,000 in income will be paid as wages and salaries to tourism industry employees. As a result of this increase in income, these employees will spend more in the local region for an array of household products and services. Assuming a sales multiplier of 2.0 to indicate that each dollar of direct sales generates another dollar of secondary sales implies that the $700,000 in direct sales within the region leads to a $1.4 million increase in regional sales as a result of the additional tourists visiting the area. These secondary sales create additional income and employment in the region, with the estimated impact dependent on the multipliers for each particular region. Assume in our case that the total impact of the increase in tourism after applying multipliers is $1.4 million in sales, $650,000 in income and 35 jobs.

Although hypothetical, the numbers used in this example are fairly typical of those used in a tourism economic impact study. Through indirect and induced effects, changes in tourist spending can affect almost every sector of the economy to some extent. The magnitude of these effects depends strongly on the extent to which businesses and households in the region purchase goods and services from local suppliers as well as how much household income is affected by the changes in spending. When a large employer closes a plant, the entire local economy may be negatively affected as retail stores close and leakages of spending from the region increase as consumers go outside the region for more of their goods and services. Similar effects in the opposite direction are observed when a new facility opens and there is a significant increase in household income (Stynes, 2000).

In addition to simply estimating the total regional impact, more detailed studies identify the sectors that receive the direct and secondary effects. They may also identify distinct market segments and identify differences in spending and impact between these subgroups. This information is sometimes used to target marketing efforts towards tourists with particular characteristics that are likely to lead to the largest economic impact per marketing dollar. It may also be used simply to better understand the distribution of impacts and to gain a better measure of the expected effects of a change in regional spending. Effects on tax revenues may also be examined by applying local tax rates to changes in sales and income.

The economic impacts resulting from a change in spending are typically measured by

- ➤ estimating the change in the number and types of visitors to the region due to the proposed change in policy,
- ➤ estimating average levels of spending (often within market segments) of visitors in the local area, and
- ➤ providing the estimated change in direct spending as input into a regional economic model to determine secondary effects.

Estimates of changes in visitor activity usually come from a demand model or professional judgment about the changes in visitation likely to take place. This step is often the weakest link in tourism impact studies because most regions do not have accurate counts of

visitors, let alone models for predicting changes in visitation (Stynes, 2000).

Spending averages are usually derived from visitor surveys or may be adapted from other similar studies. Because of differences in visitors, these data are often provided for different segments of the visitor population due to variations in spending patterns based on whether visitors stay overnight, the accommodations they choose, the type of transportation they are using, and other characteristics of their stay.

One of the primary methods used to estimate the secondary economic impacts of a particular action or policy is to apply an input-output (I-O) model. I-O models are mathematical models that describe the relationship between sectors in a region's economy. Regional I-O models are commonly used to estimate the benefits or costs of an event on the economy of a given region. These models are used to estimate linkages among sectors of the economy such that an event directly affecting one sector of the economy can be traced through the impact on the entire regional economy. This approach permits estimation of both the direct impacts in the affected sector as well as indirect impacts that occur as the change in spending by the directly affected industry works its way through the economy. Based on production functions estimating the inputs that each industry must purchase from every other industry to produce their output, these models predict flows of money between sectors. These models also determine the proportion of sales that end up as income and taxes. Multipliers are estimated from I-O models based on the estimated recirculation of spending within the region. The higher the propensity for households and firms within the region to purchase goods and services from local services, the higher the multipliers for the region will be. A number of important assumptions are involved in using I-O models. Some of the basic assumptions include the following:

- **Constant Returns to Scale.** Each industry's production function is assumed to have constant returns to scale. This means that, to produce additional output, all inputs increase proportionately (i.e., if output in an industry were to double, then that industry would double its use of all inputs). Because labor is one of the inputs into production, this implies that jobs will change in exactly the same proportion as output.

- **No Supply Constraints.** Supplies are unlimited. All industries have access to unlimited quantities of raw materials at a constant price with output limited only by demand.
- **Fixed Commodity Input Structure.** This assumption implies that price changes do not cause a firm to purchase substitute goods. This structure assumes that changes in the economy affect the industry's output but not the mix of inputs it uses to make its products.
- **Homogeneous Sector Output.** The proportion of all the commodities produced by an industry will remain the same, regardless of total output. An industry will not increase the output of one product without proportionately increasing the output of all its other products.
- **Industry Technology Assumption.** This assumption is important when data are collected on an industry-by-commodity basis and then converted into industry-by-industry data. It assumes that an industry uses the same technology to produce all of its products. In other words, an industry has a primary product and all other products are by-products of the main product.
- **Identical Firms.** All firms in a given industry employ the same production technology and produce identical products.
- **Model Parameters.** The various model parameters are accurate and represent the current year. These models rely on the national system of accounts to generate model parameters based on standard industrial classification codes and various federal government economic censuses. They are usually at least a few years out-of-date, although this is not usually a major problem unless the region has changed significantly.
- **Induced Effects.** Multiplier computations for induced effects assume that jobs created by additional spending are new jobs involving local households. The induced effects of new spending are calculated assuming linear changes in household spending with changes in income.

These assumptions are necessary to estimate an economic impact model using a typical regional I-O model. However, these assumptions lead to several limitations as noted by Hamilton et al. (1991); Coughlin and Mandelbaum (1991); and Stabler, Van Kooten, and Meyer (1988), among others. Most of these issues apply to alternative models as well and should be considered in interpreting the results of economic impact analyses in general. Some of the biggest limitations associated with this type of analysis are discussed below.

First, all production inputs have an associated opportunity cost. Thus, these opportunity costs should be included in the net benefits calculation, although this is often not considered in an economic impact analysis. Net benefits equal impacts less opportunity costs. In the case of full employment, perfect resource mobility, and absence of scale economies, benefits of a policy, action, or project would be zero because all factors employed as a result could have received the same return without the policy, action, or project in alternative uses. Typically, applications analyzing regional economic analysis assume that there is not full employment and complete mobility in the region being analyzed, but the change in net benefits will still be reduced if opportunity costs are considered.

Another issue is that multipliers estimate short-term changes, ignoring a regional economy's long-term adjustments. Thus, most of the economic effects identified in economic impact analysis are likely to be only transitory as the regional economy adjusts to the change. For example, if jobs are lost in a region because of new regulations, some of this reduction will be temporary because some of the workers whose jobs were eliminated will find new jobs in the region.[1]

Also, if some workers relocate in response to a change in the regional economy, then it is not entirely clear who should be counted in the region when calculating the benefits and costs associated with a change. For example, a new project located in a particular region may attract resources from outside the region. It is not clear that income to these immigrant resources should be counted as regional benefits of the project because people originally from the region do not benefit. However, I-O models typically make no distinction between jobs and sales, for example, going to those people already within the region and benefits going to those people outside the region.

Furthermore, applying multipliers is difficult if industries will move to different points on their cost curves as a result of the change and there are economies or diseconomies of scale. Because I-O models are based on fixed coefficients, they are not able to capture these

[1]Some workers may not find jobs within the region, even in the long run. The loss of workers who leave for jobs in other regions may tend to slow the region's growth, but such restructuring ultimately improves national economic performance by redistributing resources to their most efficient use.

impacts. These models assume that there are no supply constraints such that industries will not change their relative purchases from other sectors. This requires excess regional production capacity and excess regional labor so that use of these resources can be increased without a change in prices. In many areas, this is unlikely to be the case. Instead, increasing scale may lead to an increase in the price of labor and other resources and may cause a change in the mix of inputs used for production. It may also lead to the use of a different proportion of inputs being purchased from outside the region, which will affect the estimated change in final demand for regional output.

Some additional difficulties with applying regional multipliers include the following:

- multipliers are based on political boundaries (e.g., counties, states) instead of economic areas;
- multipliers may not be constant over time;
- different production functions for different activities are lumped together; and
- information on the relationships between producers in a region is lacking, which makes constructing an accurate set of multipliers very difficult.

Despite these caveats on the use of multipliers, regional I-O models are still considered the best way currently available to cost-effectively estimate the regional impacts of a change that will affect the local economy.

Appendix B: Social Benefits and Costs of Personal Watercraft Restrictions

The purpose of benefit-cost analysis is to evaluate the social welfare implications of a proposed action—in this case the regulation of PWC use in national parks. That is, it assesses whether the action generates benefits to society (gains in social welfare) that are greater than the costs (losses in social welfare). The following sections provide detailed descriptions of the range of social benefits and social costs that may result from PWC restrictions and discuss the ways in which these benefits and costs can be conceptualized and measured.

B.1 SOCIAL BENEFITS OF PWC RESTRICTIONS

PWC use in national parks may be associated with a number of negative impacts on environmental resources and ecosystems. One result of any negative impacts that occur is that they impose welfare losses on individuals who value the parks' environmental systems. The benefits of PWC restrictions can therefore be thought of and measured as the reduction in these losses to society. In addition, PWC use can negatively affect society in ways that are not directly related to the environment; therefore, the benefits of PWC restrictions must also include reductions in these nonenvironmental losses. Both broad categories of benefits—environmental and nonenvironmental—are discussed in more detail below.

B.1.1 Environmental Benefits

The use of PWC may have adverse impacts on the aesthetic qualities of the park, on human health, and on the park's ecosystems. The benefits associated with avoiding these impacts are described below.

Aesthetic Benefits

Among the largest and most directly damaging impacts associated with PWC use in national parks are its effects on the aesthetic qualities of park air and specifically the park soundscape. The natural soundscape is considered a natural resource of the park, and NPS attempts to prevent or minimize unnatural sounds that adversely affect the natural soundscape. National parks are especially valued for their pristine and undisturbed environments, which are often experienced by visitors through natural vistas and through the relative absence of visible or audible human activity (NPS, 2000b). The improvement or preservation of these aesthetic qualities, either in the form of reduced noise pollution or improved visibility, is therefore a potentially important source of benefits from reducing PWC use.

Noise Reduction. Perhaps the most noticeable and intrusive aspect of PWC is the level of sound they emit during normal operation. PWC have been measured to emit 65 to 105 decibels (dB) per unit, which may disturb visitors on the land and on the water. Noise limits established by NPS require vessels to operate at less than 82 dB at 82 feet (from the shoreline). The amount of noise from a PWC can vary considerably depending on its distance from another park visitor and whether it is in the water or in the air. Noise dissipates by 5 dBs for each doubling of distance from a 20-foot circle around the source and a PWC that is airborne is 15dBA louder than one that is in the water (Komanoff and Shaw, 2000). To put these noise-level estimates into perspective, Table B-1 also compares them with those of other familiar sounds.

PWC users tend to operate close to shore, to operate in confined areas, and to travel in groups, making noise more noticeable to other recreationists. Noise impacts from PWC use are caused by frequent changes in pitch and loudness due to rapid acceleration, deceleration, and change of direction. PWC noise intrudes in

Table B-1. Comparative Noise Emissions

Source	Decibel Level
Firearms	140
Motorcycle	90–110
Snowmobiles	73–100
Vacuum cleaner	70
PWC	65-105
Normal conversation	60
Normal breathing	10

otherwise quiet soundscapes, such as in secluded lakes, coves, river corridors, and backwater areas. Also, PWC use in areas where there are nonmotorized users (such as canoeists, sailors, and kayakers) causes conflicts between users.

Those who are most likely to benefit from reductions in PWC-related noise pollution in national parks are other park visitors and recreators, in particular those engaged in recreational activities that take place by the water, such as fishing, hiking, birdwatching, canoeing, kayaking, and swimming.

Several studies have shown that noise from motorized vehicles diminishes the recreational experience of other users. Several studies have found disamenities associated with various forms of mechanized recreational activities or other "technology-related" noises in recreation areas (Beal, 1994; Ivy, Stewart, and Lue, 1992; Bury and Luckenbach, 1983; Baldwin, 1970; Bury, Wendling, and McCool, 1976; Dunn, 1970; Lucas and Stankey, 1974; O'Riordan, 1977; Sheridan, 1979; Wagar, 1977).

Relatively few studies have specifically estimated the (negative) value of noise externalities on other recreators. One exception is a recent analysis conducted by the Federal Aviation Administration (FAA) to estimate the benefits of a regulation to restrict commercial air tours in Grand Canyon National Park (GRCA) (FAA, 2000). Using visitor-day value estimates from existing studies ranging from $37 to $92 (for backcountry, river, and other users of the park), the analysis assumed that these visitor-day values would be reduced in

relation to the how much aircraft noise interfered with the enjoyment of GRCA. Information about how aircraft noise affected different recreators was provided by a separate survey study of GRCA visitors. The survey found, for example, that for backcountry visitors 21 percent were "slightly" affected and 2.5 percent were "extremely" affected by the aircraft noise. In the FAA analysis, visitor value-days were assumed to be reduced by 20 to 80 percent depending on the percentage of respondents who indicated that their enjoyment of the park was "slightly," "moderately," "very," or "extremely" affected by the noise.

Another example of such a study that focuses specifically on the noise impacts of PWC is one that has examined the losses that PWC users impose on other beach recreators (Komanoff and Shaw, 2000). This study assumed that an average beach day (per person) is worth between $10 for a popular beach and $30 for a secluded one and that each 10 dB increase in background noise decreases these values by 10 percent. The assumptions about the size of the decrease in value from increases in noise come from studies on the increased property values for houses in quiet neighborhoods. Assuming also that each 1 dB noise level increment reduces the value of a beach day by 1 percent, the study found that beachgoers suffer an average loss in recreation value of between $0.50 and $7.40 per jet ski cluster (1.6 jet skis over the course of a day) per person per day.

Other evidence regarding the noise-related losses imposed by PWC can be gleaned from studies that have examined the effects of congestion on recreation values. In these studies, congestion is often measured as the number of encounters with other recreators, which may be thought of as being roughly equivalent to hearing the sound of PWC. For example, in a study of backcountry recreators in the Caribou-Speckled Mountain Wilderness in Maine, Michael and Reiling (1997) found that weekend visitors experienced losses of $22.3 (in 1990 dollars) per visit if they encountered more groups than expected.

Visibility Improvements. Several studies by the NPS and others have demonstrated the importance of visual air quality for visitors' (and nonvisitors') enjoyment and appreciation of national parks. Nevertheless, visual air quality has been and continues to be threatened at many national parks across the country. Emissions

from PWC in these parks are one of many potential (albeit, a relatively small) sources of these visibility impairments.

Although visibility effects can be characterized and measured in several different ways, "regional haze," which uniformly reduces visual range and therefore impairs the appreciation of natural vistas, has been a particular source of concern. The primary contributors to regional haze and visibility impairments in general are small particles (particulate matter or PM) in the atmosphere that scatter and absorb light. There are several different sources and types of particles in the environment; however, sulfates (and to a lesser extent nitrates), primarily from the combustion of fuels, are the largest contributors to visibility reduction, especially in the eastern portions of the U.S. (Malm, 1999). Nationwide, the largest sources of sulfur dioxide emissions that contribute to sulfates in the atmosphere are power plants and other industrial sources. Mobile sources, such as cars, trucks, and buses (and PWC), account for the largest portion of NO_X emissions, which contribute to nitrates.

Emissions factors per hour are not available for PWC but because PWC are powered by the same type (two-stroke) of engine as snowmobiles, snowmobile emissions factors may serve as a reasonable proxy. Table B-2 compares typical emissions rates for snowmobiles and other vehicles for NO_X and PM. These are the pollutants that are the most likely contributors to visibility impairments from PWC emissions. These emissions rates vary greatly across types and uses of these vehicles; however, the table shows that PM emissions for snowmobiles are particularly high relative to automobiles. The California Air Resources Board found that a 7-hour ride on a PWC powered by a conventional two-stroke engine produces the same amount of smog-forming emissions as over 100,000 miles driven in a modern passenger car. It should also be noted, however, that automobiles account for a very small portion of PM emissions nationwide.

The estimates in Table B-2 suggest that PWC can be a source of visibility impairment in national parks, but their contribution to overall levels of regional haze in these areas is likely to be negligible. Nevertheless, in high-use areas and periods, they may negatively affect visual air quality in a noticeable way.

Table B-2. Comparative Emissions Factors for Snowmobiles and Other Vehicles: NO_x and PM

	NO_x	PM
Snowmobiles (lbs per 4 hr visit)	0.06	0.2
Automobiles (lbs per 4 hr drive[a])	0.09–0.41	0.02
Diesel buses (lbs per 4 hr drive[a])	3.22	0.26

[a]Assuming an average speed of 25 mph.
Source: NPS, 2000a.

Several studies have investigated U.S. households' values for improvements in visibility at various national parks across the country. All of these studies have found a significant WTP by both users and nonusers for visibility improvements. One study in particular (Chestnut and Rowe, 1990) found that the average household in the southeast U.S. would be willing to pay $68 (in 1999 dollars) per year for a doubling of the visual range in national parks in the southeast U.S.

Human Health Benefits

In addition to NO_x, ozone, and PM, PWC emissions typically contain a number of other pollutants, including CO, a conventional air pollutant that is commonly associated with mobile sources. It also includes a number of potentially toxic HC pollutants—benzene, 1,2-butadiene, formaldehyde, and acetaldehyde—and ammonia. As described in Table B-3, inhalation of these pollutants is associated with a wide variety of potential adverse health effects.

The extent to which the health effects listed in Table B-3 result from PWC emissions depends on the level and duration of exposure. Unfortunately, there is too little data and too much uncertainty to reliably estimate the incidence of these health effects. For comparative purposes, however, Table B-4 compares emissions rates of HCs and CO for snowmobiles (as in Table B-2, snowmobile emissions factors serve as a proxy for those of PWC) and for other vehicles.

The comparisons for CO are particularly relevant since highway vehicles account for over 50 percent of total CO emissions in the country (EPA, 2000b). Although the measures of vehicle use in the emissions factors are different across vehicles, the rates of HC and

Table B-3. Health Effects Associated with Pollutants in PWC Emissions

	Carcinogenic Effects	Other Chronic Health Effects	Acute Health Effects
Particulate matter (PM)	None	Chronic bronchitis	High-level exposure: mortality, acute bronchitis Low-level exposure: cough
Carbon monoxide (CO)	None	Aggravation of cardiovascular disease	High-level exposure: visual and mental impairment
Nitrogen oxides (NO_X)	None	Reduced pulmonary function	High-level exposure: cough, fatigue, nausea Low-level exposure: lung irritation
Benzene	Known human carcinogen	Anemia and immunological disorders	High-level exposure: dizziness, headaches, tremors
1,3-Budatdiene	Probable human carcinogen	Birth defects, kidney and liver disease	High-level exposure: neurological damage, nausea, headache Low-level exposure: eye, nose, throat irritation
Formaldehyde	Probable human carcinogen	NA	NA
Acetaldehyde	Possible human carcinogen	Anemia	High-level exposure: pulmonary edema, necrosis Low-level exposure: eye, skin, lung irritation
Ammonia	None	NA	High-level exposure: eye and lung irritation

NA = Not available

Sources: EPA, 2000a; EPA, 1999a.

Table B-4. Comparative Emissions Factors for Snowmobiles and Other Vehicles: HC and CO

	HC	CO
Snowmobiles (lbs per 4 hr visit)	19.84	54.45
Automobiles (lbs per 4 hr drive[a])	0.09–0.44	0.75–3.24
Diesel buses (lbs per 4 hr drive[a])	1.23	4.45

[a]Assuming an average speed of 25 mph.

Source: NPS, 2000a.

CO emissions for snowmobiles are distinctly higher than for automobiles and diesel buses. As a result, national park visitors recreating near areas where PWC use is permitted may be exposed to particularly high levels of CO and certain HCs.

Restrictions on PWC use in national parks could potentially reduce harmful exposures to park visitors and workers, particularly for individuals who spend extended periods in high-use areas. The benefits of these restrictions can be expressed as the value of reductions in the incidence (i.e., the number of cases avoided) of harmful health effects, in particular those effects described in Table B-3. As previously mentioned, the total number of avoided health effects is not known; however, using information from a recent EPA study of the benefits of air pollution regulations (EPA, 1997), Table B-5 provides a summary of "unit" values for selected health effects. Based on a review and synthesis of several health valuation studies, these values represent best estimates of individuals' average WTP to avoid a single case of the health effect. In the absence of more complete information on the total health benefits of reducing PWC use, these values provide a rough sense of the magnitude and relative size of the benefits associated with avoiding specific health effects that may result from acute exposures.

Table B-5. Unit Values for Selected Health Effects

Health Effect	Unit Value (mean estimate) (1999$)[a]
Acute bronchitis	$57
Acute asthma	$41
Acute respiratory symptoms	$23
Shortness of breath (one day)	$6.8

[a]All amounts inflated using the consumer price index available from the U.S. Bureau of Labor Statistics, 2000.

Ecosystem Protection Benefits

To the extent that damages to park ecosystems occur, their cumulative effect is to reduce the "ecological services" that these systems provide to individuals and households across the country. National park ecosystems are particularly valued for their unique

biological, cultural, and geological resources and the recreational and other services they provide. A vast majority of park visitors (i.e., users) experience and enjoy the natural systems of the park through a wide variety of recreational activities (wildlife viewing, hiking, fishing, as well as using PWC). However, even individuals who are not park visitors (i.e., nonusers) can benefit from the knowledge that park resources are being protected and preserved. These nonuse values can stem from the desire to ensure others' enjoyment (both current and future generations) or from a sense that these resources have some intrinsic value. Evidence of such nonuse values for park protection is provided in studies that have documented significant WTP by nonusers for improved air quality at parks (e.g., Chestnut and Rowe, 1990) and, more generally, for the protection of unique species and ecosystems (see, for example, Pearce and Moran [1994] for a review of such studies). Restrictions on PWC use in national parks can therefore provide benefits to both users and nonusers in a number of ways by protecting the parks' ecological resources.

B.1.2 Nonenvironmental Benefits

Restrictions on PWC use in national parks can also improve societal welfare in ways that are not directly related to environmental quality in and around the parks. These potential nonenvironmental benefits are described below.

Public Safety Benefits

With the increase in PWC use in recent years has come an increased concern relating to the health and safety of operators, swimmers, snorkels, divers, and other boaters. A study conducted by the National Transportation Safety Board (NTSB) in 1998 revealed that although recreational boating fatalities have been declining, PWC related fatalities have increased in recent years (NTSB, 1998). PWC accident statistics provided by the U.S. Coast Guard supports the increase in PWC-related fatalities. Within the U.S. five PWC-related fatalities occurred in 1987 and 68 PWC-related fatalities occurred in 2000. However, the peak occurred in 1997, with 84 PWC-related fatalities. Since 1997, PWC-related accidents, injuries, and fatalities have decreased. Following this same pattern, the percentage of PWC out of all boats involved in accidents have decreased from 36.3 percent in 1996 to

29.6 percent in 2000. The increases and decreases in PWC accidents, injuries, and fatalities are comparative to the number of PWC sales and number of PWC owned (U.S. Coast Guard, 2001).

Restrictions on PWC use in national parks would certainly reduce the number of such incidents in the parks.[1] The primary beneficiaries would be the PWC users themselves, whose safety would be protected; however, these benefits may be implicitly accounted for in the consumer surplus changes (see Section B.2) that these recreators experience as a result of the restrictions.[2] Other summer recreators (non-PWC) might also benefit if they would otherwise be at risk of being involved in accidents with PWC. In addition, PWC accidents can impose costs on NPS and other local state and local government agencies that are responsible for providing medical, rescue, and related assistance. Reductions in PWC accidents in national parks would therefore allow some of the resources devoted to these activities to be diverted to other publicly beneficial uses.

Avoided Infrastructure Costs

Allowing PWC in national parks requires NPS to develop, maintain, and operate an infrastructure to support these activities. In particular launch sites and buoys must be designated, maintained, and monitored. The costs associated with these activities vary widely across parks, depending on the physical characteristics of the parks and the level of PWC use permitted.

By restricting PWC use, some of these infrastructure-related costs can be avoided or reduced. As a result some of the resources devoted to these activities can also be diverted to other publicly beneficial uses.

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[1] The benefits of these reductions may be offset to some degree by increased PWC usage and accidents in areas outside the parks.

[2] To the extent that PWC users are aware of the safety risks they face, the potential losses to themselves from accidents should already be factored into their consumer surplus from using a PWC. This implies that the safety benefits to these individuals from reducing PWC use are implicitly accounted for (i.e., deducted from) the consumer surplus losses to these recreators.

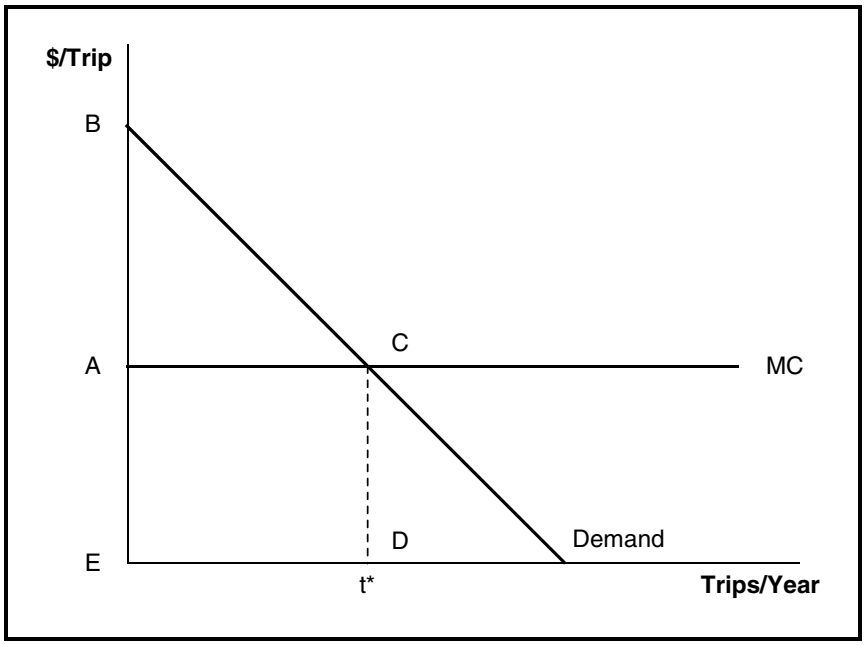
B.2 SOCIAL COSTS OF PWC RESTRICTIONS

The primary losses associated with PWC use restrictions in national parks will accrue to

- ➤ PWC users, in particular individuals who will not PWC in the park as a direct result of the restrictions, and
- ➤ providers of PWC-related services for park visitors.

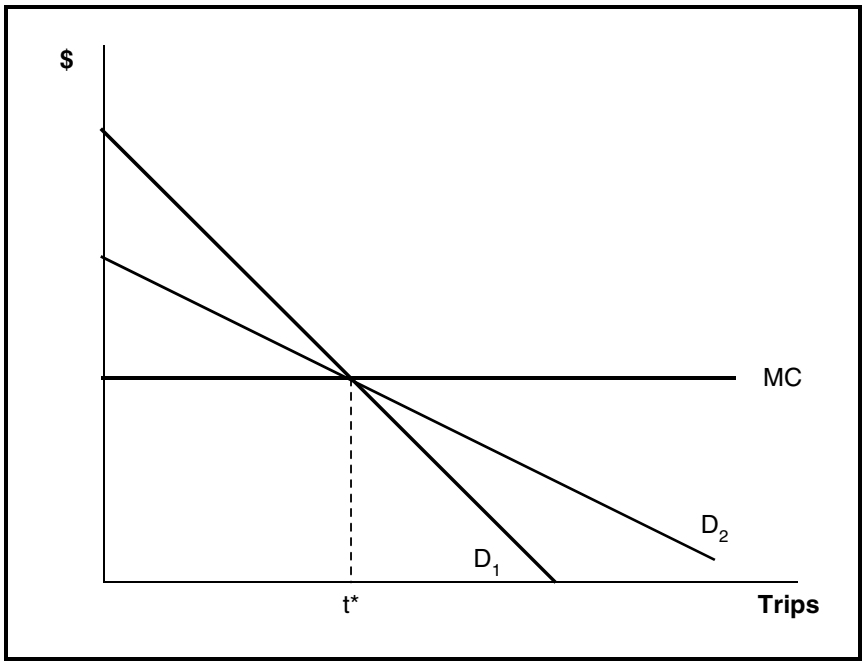
The welfare losses to individual consumers (PWC riders) are measured by their loss in consumer surplus. Consumer surplus is measured as the difference between the total cost of a product or activity to the consumer and the total amount the individual would be willing to pay for that activity. In the context of recreation activities, Figure B-1 depicts an individual demand curve for PWC trips, the marginal cost of a trip (MC, assumed to be constant), and the optimal number of trips per year, t*. The triangle ABC measures the consumer surplus associated with this optimal number of trips—the difference between what the individual paid for the trips, ACDE, and the total WTP for the trips (the area underneath the demand curve), EBCD.

Figure B-1. Consumer Surplus



The extent of the welfare loss to an individual rider depends crucially on the availability of substitute activities. Figure B-2 depicts two alternative demand curves for PWC trips to a particular waterbody. The slope of the demand curve reflects the number of substitute activities available to a particular individual and the preferences of that individual toward those substitutes. The flatter demand curve, D_2, indicates that this individual has a variety of close substitutes for PWC use in this area (these substitutes could include PWC riding in a different area or participating in a different activity such as motorboating). The individual with the steeper demand curve, D_1, has fewer substitute activities he/she enjoys as much as using his/her PWC in this waterbody. If both individuals choose the same number of trips, as in Figure B-2, the person with the steeper demand curve, D_1 (fewer substitutes for PWC use) receives greater consumer surplus from use in this particular waterbody and thus will experience a greater loss in welfare if the waterbody is closed.

Figure B-2. Consumer Surplus and Substitute Activities



The change in welfare for businesses is measured by producer surplus, or the area AP*B in Figure B-3, where P* is the market price of the good, for example a PWC rental. Producer surplus measures the difference between total revenue and variable costs. If the firms face an upward- sloping marginal variable cost (MC) curve, then a decrease in demand, indicated in Figure B-4 from D to D′ will result in a lower producer surplus for PWC rental companies.

Figure B-3. Producer Surplus

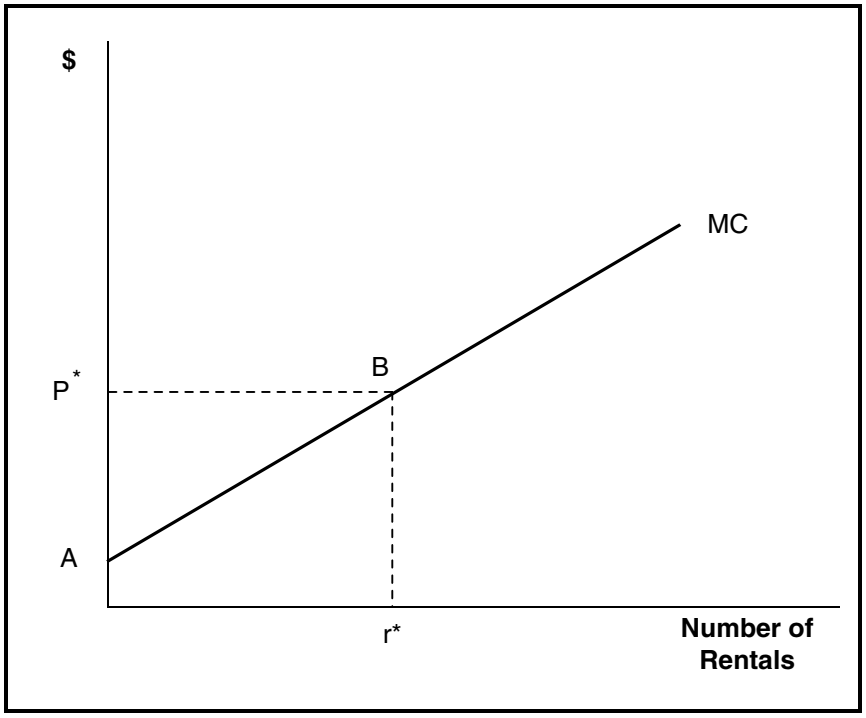
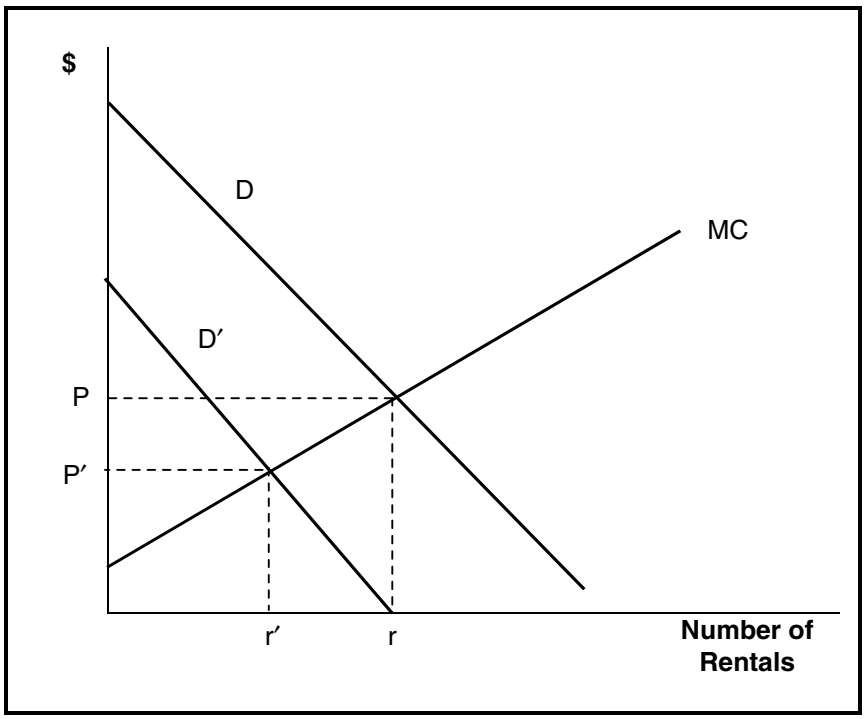


Figure B-4. Producer Surplus and a Change in Demand



If PWC riding decreases as a result of the regulation, then the suppliers of PWC and other tourism-related services will be affected, including rentals and sales of PWC and PWC accessories, lodging, meals, and other tourism-related expenditures. If demand for other types of recreation related rentals increases, then some businesses may experience an offsetting increase in producer surplus.